

Annual Ornamental Flowers as Sustainable Floral Resources for Pollinators

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Pollinators are essential components of terrestrial ecosystems because they facilitate the transfer of pollen between flowers and contribute to the reproduction of a large proportion of flowering plants. Bees, butterflies, moths, hoverflies, beetles, birds and other flower-visiting organisms contribute to pollination directly or indirectly. In addition to their ecological importance, pollinators provide valuable ecosystem services to agricultural and horticultural systems. The increasing loss of natural habitats, urban expansion, intensive farming, pesticide exposure and changing climatic conditions have created serious challenges for pollinator populations. One of the important approaches to address these challenges is to increase the availability of suitable floral resources throughout the growing season.



Floriculture has traditionally focused on flower production, visual appeal, fragrance, vase life and market value. However, modern floriculture is increasingly considering ecological functions in addition to aesthetic and economic characteristics. This has resulted in growing interest in pollinator-friendly floriculture, in which ornamental plants are selected and managed to provide food and habitat for beneficial insects while maintaining commercial and ornamental value.

Annual ornamental flowers have considerable potential in this context. Unlike many perennial plants, annuals complete their life cycle within one growing season and can produce substantial floral biomass over a relatively short period. Their flexible production cycle allows growers and landscape managers to introduce flowering plants during periods when natural floral resources are scarce. They can also be incorporated into flower beds, borders, balconies, rooftop gardens, public parks, home gardens and agricultural landscapes.

Importance of Annual Ornamental Flowers for Pollinators

Flowers provide two major nutritional resources to many pollinators: nectar and pollen. Nectar is an important source of carbohydrates, while pollen provides proteins, lipids, vitamins and minerals. The quantity, quality and accessibility of these resources vary among plant species and cultivars. Consequently, simply increasing the number of flowering plants does not always guarantee that a landscape will provide adequate resources for all pollinator groups.

Annual ornamental flowers can be particularly useful because many species have prolonged or repeated flowering. Plants such as zinnia, marigold, cosmos and sunflower can produce numerous flowers over extended periods when appropriately managed. This continuous supply can help reduce periods of floral-resource scarcity, especially in urban and suburban environments where natural vegetation is fragmented. Annual ornamentals can also provide resources to a broad range of insects. Open, easily accessible flowers may be visited by honey bees, solitary bees, bumble bees, butterflies and hoverflies. The diversity of visitors depends on flower structure, resource availability, surrounding vegetation and local environmental conditions. Research on annual ornamental flowers has demonstrated that pollinator abundance and diversity can vary among plant genera, cultivars, seasons and years. Therefore, selecting a mixture of suitable ornamental plants is generally more beneficial than relying on a single flower type.

Floral Characteristics Influencing Pollinator Attraction

Pollinator attraction is influenced by several characteristics of flowers. Flower colour is one of the most visible traits and can influence the ability of insects to locate flowers. Bees are particularly responsive to colours within the ultraviolet, blue, violet and yellow ranges, while butterflies are often attracted to brightly coloured flowers. However, colour alone does not determine pollinator preference.

Flower shape and accessibility are also important. Flowers with exposed reproductive structures and accessible nectar and pollen can be utilized by a wider range of pollinators. Tubular or highly specialized flowers may favour particular groups with suitable mouthparts. Conversely, highly modified flowers may restrict access to floral resources.

The arrangement of petals can also influence resource accessibility. Some ornamental breeding programmes have selected for highly doubled flowers because of their greater visual appeal. However, excessive doubling may reduce access to reproductive structures and decrease the availability of pollen and nectar. Therefore, ornamental value and ecological value should both be considered when selecting cultivars for pollinator-friendly landscapes.

Flowering duration and abundance are equally important. A plant producing a large number of flowers for a long period can provide more consistent resources than a plant with a short flowering period. For this reason, combinations of annual species with different flowering periods can create a continuous floral calendar.

Potential Annual Ornamental Crops for Pollinator-Friendly Floriculture

Several annual ornamentals can be incorporated into pollinator-friendly production systems.

Marigold (*Tagetes spp.*) is widely cultivated because of its attractive flowers, adaptability and economic importance. Its bright flowers can attract bees and other flower-visiting insects. Both African marigold and French marigold can be considered in diversified floral plantings.

Zinnia (*Zinnia spp.*) is another valuable ornamental because of its prolonged flowering and wide range of colours. Its open flower heads can provide accessible resources for bees and butterflies and make it suitable for gardens and landscape plantings.

Cosmos (*Cosmos spp.*) produces relatively open flowers and can provide floral resources for various insects. Its extended flowering period makes it useful for maintaining floral availability during parts of the growing season.

Sunflower (*Helianthus annuus*) is particularly valuable because of its large flower heads and abundant pollen. It can function both as an ornamental crop and as a resource-producing plant in diversified landscapes.

Calendula (*Calendula officinalis*), salvia (*Salvia spp.*), celosia (*Celosia spp.*) and other annual ornamentals can further increase the diversity of available floral resources. A mixture of plants differing in colour, shape, flowering period and resource availability can potentially support a broader range of flower visitors.

Role of Cultivar Selection

Cultivar selection is an important but sometimes overlooked component of pollinator-friendly floriculture. Different cultivars within the same ornamental species can vary in flower size, number of petals, nectar production, pollen availability, colour and flowering duration. These differences can influence pollinator visitation.

Therefore, ornamental breeding and cultivar evaluation should not focus exclusively on visual characteristics. Cultivars could also be screened for ecological traits such as nectar availability, pollen production, flower accessibility and attractiveness to different pollinator groups. Such evaluation could help identify cultivars that combine desirable ornamental characteristics with ecological benefits.

An important research opportunity exists in comparing single-, semi-double- and double-flowered cultivars. Single flowers often provide easier access to reproductive structures, while highly double flowers may have modified floral architecture. However, the actual effect can vary among species and cultivars and should therefore be evaluated experimentally rather than assumed.

Developing Pollinator-Friendly Floriculture Systems

A successful pollinator-friendly floriculture system should provide continuous, diverse and accessible floral resources. Instead of cultivating only one ornamental crop, growers can develop mixtures of annual species with complementary flowering periods. Such diversification can improve the availability of flowers throughout the season.

The use of pesticide inputs should also be carefully managed. Broad-spectrum insecticides can negatively affect non-target insects, including pollinators. Integrated pest management, biological control, cultural practices and targeted pest management should therefore be encouraged wherever possible.

Landscape design can further increase the ecological value of floricultural systems. Flower beds can be arranged to provide patches of different flower colours, shapes and heights. Unused field margins and spaces around commercial flower production areas can be planted with suitable flowering species to provide additional resources.

Conclusion

Annual ornamental flowers have considerable potential to contribute to pollinator conservation while maintaining the aesthetic and economic functions of floriculture. Their short production cycles, diverse flower characteristics and capacity for prolonged flowering make them useful components of pollinator-friendly landscapes. Marigold, zinnia, cosmos, sunflower, calendula, salvia and other annual ornamentals can provide nectar and pollen to a range of flower-visiting insects when appropriate species and cultivars are selected. The development of pollinator-friendly floriculture should move beyond simply increasing the number of flowers. Greater emphasis should be placed on floral diversity, resource availability, flower accessibility, flowering continuity and cultivar selection. Reduced dependence on harmful pesticides and integration of diverse flowering plants can further strengthen the ecological value of ornamental production systems. Thus, pollinator-friendly floriculture represents an opportunity to integrate commercial flower production, landscape aesthetics, biodiversity conservation and sustainable horticulture. Future research should focus on identifying ornamental species and cultivars that provide reliable floral resources while retaining desirable commercial characteristics. Such research can contribute to the development of floriculture systems that are not only attractive and profitable but also supportive of pollinator biodiversity.