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Monarda —A Potential Floricultural Plant for Temperate India

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Abstract

Despite India is endowed with diverse agro-climatic conditions like good quality soils, suitable climate, abundant water supply, low labor cost, the global floriculture industry is growing comparatively at a faster pace than in India. Though the floriculture industry in India has huge potential currently has only 0.3% share of the world market with export of around $30 million. Growing of latest varieties and quality control are one of the key issues that need to be addressed properly to speed up this export oriented agro-industry. To over come this bottleneck we have to widen the genetic resources for stronger Indian floriculture industry, India has to march ahead from self-sustained to proud export oriented floriculture industrialized nation. In India, temperate floriculture genetic resources are not enough to sustain domestic and global market. To produce quality rich floriculture which can pass the international market we need quality genetic stock and improved varieties, for that there is need to plan and execute systematic introduction and exchange program for required plant genetic resources with the desired country through bilateral or multilateral program. Monarda, native to the Canadian is usually sold for the beauty of their striking blossoms may yield an essential oil high in geraniol content. When this native species is crossed with *M. didyma*, vigorous hybrids, yielding essential oils rich in geraniol, linalool, thymol, carvacrol, 1-, 8-cineole, and other terpenes can be produced. Introduction of Petite Wonder (EC 538844) variety of *Monarda* from Canada during 2004 is the second dwarf Monarda hybrid cultivar developed from a series of open-pollinated crosses in a lineage originating from cv Souris. It is characterized by good winter hardness and a high resistance to powdery mildew under the field conditions of Manitoba, Canada. The propagation of Monarda is briefly discussed.

Key words : Monarda, Propagation, Floricultural plant.

India has diverse agro-climatic regions comprising tropical, sub-tropical and temperate regions, where we can grow various kinds of crops including ornamental plants. After liberalization, the government of India identified floriculture as a sunrise industry and accorded it 100% export oriented status. Owing to steady increase in demand of flower floriculture has become one of the important commercial trades in agriculture. Hence commercial floriculture has emerged as hi-tech activity-taking place under controlled climatic conditions inside greenhouse. Floriculture products mainly consist of cut flowers, pot plants, cut foilage, seeds, bulbs, tubers, rooted cuttings and dried flowers or leaves. Present status and growing trade in floriculture is still infancy. Floriculture in India is being viewed as a high growth Industry. Commercial floriculture is becoming important from the export angle. According to a report of the APEDA, the total area under flower crops was estimated around 34,000 hectares, which included 24,000 hectares under traditional flowers such as marigold, jasmine, aster, rose, chrysanthemum, tuberose and 10,000 hectares under modern flowers like cornation, rose, gerbera, gladiolous, anthurium. India currently has only 0.3% global market share ; it can support traditional hubs like Netherlands, Colombia and Israel if there is adequate push from the government. India's floriculture exports are likely to grow to Rs 700 crore by end of 2010 against projected level of Rs 1000 crore. We have achieved a lot particularly in the improvement of field crops and almost reached at peak. There is need to diversify the base of gene pool Indian floriculture by various means and sources ; introduction of germplasm form abroad is one of the major source for broadening genetic base. National Bureau of Plant Genetic Resources (NBPGR), New Delhi is nodel organization engaged in the various activities relate to enrichment of plant genetic re-

sources in the country. Acquisition of more exotic germplasm as early as possible has become the priority due to latest development under convention on biological diversity and other International treaties and laws, which makes flow of genetic resources bit more difficult than it was before enforcement of new laws. The germplasm / genetic material contains promising traits related to yield and yield attributing characters, quality characters and also resistance to various biotic and abiotic stresses. Germplasm of diverse crops were required for national needs which will be further distributed to various potential users (breeders/crop improvement workers) in the country for its evaluation and further utilization in their ongoing/ ensuing crop improvement works for our food and nutritional security.

Monarda is temperate ornamental plant well suited for same type of climate in India especially in the state of Jammu and Kashmir, Himanchal Pradesh, Uttaranchal and high lands of North Eastern States. Horsemint, bee balm, or wild bergamot are few names of monarda. It is an erect aromatic annual or perennial herb widely distributed throughout North America (1—4). The essential oil components of the leaves have been used to determine genetic relationships between species (5, 6). Plants of a given species from different geographical regions may, however, yield strikingly different oils. Native Americans treated skin disorders and inflammations with poultices made from various species of monarda. They also used teas and steam inhalants made from the leaves to treat respiratory difficulties. Monarda plants should be grown in full sun on a well-drained sandy soil with some moisture retentive capability (1—3). Occasional irrigation is needed in drought if soil drains excessively. It is tolerant to some drought and is generally unscathed by freezing temperatures in Florida. *Monarda didyma* is sometimes grown in Florida but does not tolerate hot/humid conditions well. It will thrive in regular soil that is moist to dry and tolerate drought. Monarda needs full of sun, except in warm summer climates, where light shade is preferred easily grown in ordinary garden soil so long as it is not too dry. Monarda grows well in heavy clay soils. Monarda requires a moist soil and a sunny position, though it also succeeds in light shade. This species thrives when grown in a dry soil. It prefers alkaline soil conditions. Plants are hardy to at least -25 C. It is an ornamental plant ; there are several named varieties. It tolerates most, prefers moist and sun ; spreads faster in shade, Wild Bergamot prefers a well-limed, rather dry soil.

Economic and Commercial Importance of Monarda

The flowers make an attractive and tasty addition to soups, salads, baked goods, jellies, and beverages. The flowers and leaves can also be used in dried floral arrangements. The essential oil of bergamot is often used in perfumery and in cosmetic preparations, particularly those formulated for dry skin conditions such as eczema and psoriasis (3, 6, 7). This herbaceous perennial may be used in the landscape as a summer ground cover in a small garden. It also presents a nice massed display in a perennial border. One should appreciate the beauty of monarda and the wide variety of colors the various species lend to any flowerbed. *M. didyma* for instance, has at least ten distinct varieties which exhibit sprays of color ranging from white, to blue, to shades of scarlet. *M. fitulosa* displays lavender blossoms, while *M. citriodora* yields pink blossoms with a heady lemon scent. Monarda is also reputed to be an excellent companion to tomatoes by improving the condition of the soil and deterring harmful insects. Leaves are used as raw or cooked (2, 5, 7). The entire plant above ground level can be used as a potherb though it is rather aromatic. It is also used as a flavoring in salads and cooked foods. The flowers make an attractive edible garnish in salads. The fresh or dried leaves are brewed into a refreshing aromatic tea. The leaves are said to have a fragrance like that of the bergamot orange (*Citrus bergamia*), which is grown almost exclusively in southern Italy and used to flavor Earl Grey Tea (4—6). Wild bergamot was often employed medicinally by several native North American Indian tribes who used it to treat a variety of complaints (2, 4—7), but especially those connected with the digestive system. The leaves and flowering stems are carminative, diaphoretic, diuretic and stimulant an infusion is used internally in the treatment of colds, catarrh, headaches, gastric disorders, and aching kidneys, to reduce low fevers and soothe sore throats. Externally, it is applied as a poultice to skin eruptions, cuts and as a wash for sore eyes. The

leaves can be harvested before the plant flowers, or they can be harvested with the flowering stems. They can be used fresh or dried. The plant contains the essential oil 'bergamot oil' which can be inhaled to treat bronchial complaints. The leaves also contain 'thimble', an essential oil that can be used to expel gas from the digestive trace. This has also shown to be effective in repelling intestinal parasites and in destroying bacteria. Essential oil is widely used in pharmaceutical preparations and food products such as beverages, ice cream, candies, baked goods, and chewing gum. The leaves have been used as an insect repellent (2, 4, 7).

Botany and Taxonomy of Monarda

Monarda is a spreading, clump-forming herbaceous perennial with the square stems and opposite leaves characteristic of herbs in the mint family (1, 2, 4). Leaves are toothed on the margins, ovate-acuminate (oval near the base and elongating to a pointed tip). 2—6 in (5—15 cm) long and about a third to a half as wide. Bruised foliage is fragrant. Monarda multiplies from its short underground stolons in spring and complete its lifecycle in winter. Monarda is a 3-4 ft (0.9–1.2 m) tall and spread out 2-3 ft (0.6–0.9 m). Each flowering stem bears one or (rarely) two whorled clusters of scarlet red flowers. The flowers are about 1.5 in (3.8 cm) long and tubular, terminating in two lips. The upper lip is erect and like a hood and the lower lip has three spreading lobes. Directly beneath the flower cluster is a whorl of reddish bracts, some leafy and some bristly. The Bergamot produces heads of flowers during the summer over an extended period, for eight weeks or more that each has a pincushion like center. The wild species mainly have red flowers (1, 2), but modern hybrids may come in red, pink purple, lavender or white. These lovely flowers attract bees and humming birds. The flowers are usually lavender, but purple, pink, or white flowers occasionally occur in wild stands. Monarda belongs to the mint family, Lamiaceae (Labiatae) and genus *Monarda.* It has several species but there are at least 17 species of *Monarda* which have been utilized as ornamental plants, food and flavoring additives, and for medicinal purposes in temperate region particularly in Canada. Some of the important characteristics of main species are listed here.

1. *Monarda citriodora* (Common Horsemint). This is famously recognized as Common Horsemint, a widespread and highly variable species as (7). The former workers recognized *Monarda citriodora*, *M. austromontana* Epling and *M. mexicana* Epling as good species, while scora (7) recognized only the latter as distinct reducing *M. austromontana* to subspecific rank. This name has been applied to localized populations along the Gulf Coastal regions of southern Texas, which mostly occur in heavy clay soils and are apparently "fixed" in their genetic proclivity for the production of reduced flowers. Such "forms" were first called to the fore as noted by scora (7) in his formalized description of the taxon. Mostly found in south central Texas in sandy clay soils ; comes into flowering during April to June (1, 4).

2. *Monarda fistulosa* (New England Horsemint). This is commonly known as New England Horsemint which is a widespread and highly variable species of temperate North America. Several workers have recognized two or more regional varieties in the complex. The var Fistulosa is thought to be largely confined to the upper New England states. Following most workers, we also recognize but two regional varieties occurring in Texas. These can be recognized by the following couplet : As indicated in the above, this is the westernmost variety of *Monarda fistulosa.* Mazza et al. (6) also accepted it as varietally distinct, Western Texas in mostly montane habitats ; comes into flowering during April to July.

3. *Monarda fruticulosa.* It is also known as South Texas Horsemint. *M. fruticulosa* is endemic to south Texas in mostly sandy soils ; comes into flowering during April to December. Suffruticose herbs to 80 cm high ; easily distinguished by its narrow greyish-green leaves (7). It was recognized as a good species and reduced it to a variety of *M. punctata.* We favor its treatment as a species since it appears not to intergrade with any of the infraspecific elements of *M. punctata* is recognized.

4. *Monarda punctata* L. This is a widespread variable species of the eastern portions of North America. Some treated the species as having eight sub-species, the typical sub-species largely confined to the Atlantic and Gulf Coastal regions of the USA. Scora (7) maintained all of these taxa, adding 3 addi-

tional ones, bringing to 11 the number of infraspecific taxa recognized. He treated all of these at the varietal level ; 9 of the 11 were said to occur in Texas. We have treated four of Scora's varieties as species (*M. fruticulosa, M. maritima, M. stanfieldii,* and *M. viridissima*) believing these to be sympatric with *M. punctata*, each occupying a restricted eco-geographic region (4).

5. *Monarda russeliana* (Russel's Horsemint). This species is closely related to *Monarda bradburiana* Beck, which has a more northerly distribution. According to Scora (7) these two species show evidence of intergradations in Oklahoma and elsewhere.

Production Techniques of Monarda

It is easily grown from seeds but division of clumps in spring is most common cuttings (softwood and root) and can also be propagated by dividing the root clumps (1, 2). Seeds are generally sown during mid to late spring in a cold frame (1, 2, 4). Germination usually takes place within 10—40 days at 20 C. Seeds should be pre-chilled in the refrigerator and then planted inside, 8 to 10 weeks before it is safe to set outdoors, in a 70 degree temperature. Seeds may also be sown outside when the soil is warm. They will re-seed themselves when large enough to handle, prick the seedlings out into individual pots and plant them out into their permanent positions in early summer. The seed can also be sown *in situ* in late summer in areas where the winters are not too severe and will produce larger plants. Monarda can be initially propagated from seeds, but if we want to propagate the cultivars, we have to start new plants by dividing the root clumps in late winter or early spring before new growth begins large divisions can be planted out direct into their permanent positions. It is better to pot up the smaller divisions and grow them on in light shade in a cold frame until they are well established before planting them out in late spring or early summer division usually needed every 3 years as centers die out and to prevent excessive spread ; it is necessary to allow air circulation and provide sufficient moisture to reduce mildew, remove spent flowers for prolonged bloom. They may be divided in early spring and replanted at 46 cm apart (1, 2, 3).

Propagation of Monarda can easily be achieved through crown divisions (1—3), but this method is cumbersome and inefficient. A more effective and rapid method of propagation has been found to be through plant cuttings of actively growing stems. Stem cuttings. approximately 10 to 12 cm in length, are taken and all but two leaves removed, including the shoot tip. The bases of the cuttings are dipped in 1,000 ppm IBA rooting compound and placed in sand in a misting chamber. Cuttings taken in early June when the plants are actively growing, produce root initials within one week and are ready for transplanting within 14 to 16 days. Propagation by tissue culture has also been successfully carried out in our laboratory using leaf cuttings. *Monarda didyma* is pretty enough, but numerous cultivars and hybrids with wild bergamot (*M. fistulosa*) are available (1, 2). Bowman has purple flowers and gets 4 ft (1.2 m) tall. Alba has white flowers. Granite Pink and Pink Delight are dwarf to 18 in (46 cm) tall, with pink flowers. Cambridge Scarlet and Jacob Kline both have brillian crimson flowers to almost 2 in (5 cm) long, and the latter is mildew resistant. Gardenview Scarlet also is mildew resistant. Mahogany has reddish brown flowers. The Panorama Hybrids are seed propagated and have flowers in various shades of red, salmon and pink. Violet Queen produces violet-purple flowers. Scorpio has purple flowers and is said to be the most mildew resistant of all. Weeds do not pose a problem in the production of monarda. Herbicides such as trifluralin, terbacil, solan, and paraquat used together with good cultural practices can maintain a weed-free plantation. Trifluralin (1.12 kg/ha) should be used pre-plant incorporated when monarda is established. In the second year and every year thereafter, paraquat can be applied before the monarda shoots reach a height of 5 cm, to kill the early spring weeds. Application of herbicides in a commercial field, however, should only be used if the chemicals are legally registered for such use on this crop. This also kills off the monarda shoots. Application of terbacil (1.68 kg/ha) and 1 to 2 cm of irrigation should followed (1, 2, 4).

Powdery mildew poses problems on the leaves, especially when the plants are stressed by dry weather. This can be treated with fungicides and diseased foliage can be removed to contain the spread (1, 2, 4). Rust is the major disease of monarda. It has

caused defoliation, girdling of stems and degeneration of plants. The disease is spread by aerial rust spores under cool, cloudy, moist weather conditions. Relatively good control has been achieved by applying a contact herbicide, paraquat, in early spring when the monarda shoots are only about 5 cm tall to destroy all vegetation and thereby remove the required host for the spore's rust (1, 2, 7). In light soils vine weevils can attack monarda (1, 2, 4). Removal of the dead flowers to prolong blooming is essential. It rarely blooms the first season. Bergamot can become a pest in moist, fertile soil. The leaf tips of the Bergamot, monarda, may be cut 2 or 3 times during the summer and used dried or fresh in teas, tisanes, and potpourris. Wild Bergamot is cultivated and harvested the same way as monarda (1—4).

Essential Oil Production

The composition of the oils obtained by hydrodistillation of the plant material varied significantly among different hybrids (3, 6, 7). Six cyclic terpenes, including alpha-phellandrene, alpha-pinene, and camphene were present in oils of seven of the eight hybrids and β-pinene ranged from 0.56 to 13.8% of the oil from these hybrids. Essential oil yield varies from about 0.65 to 1.2 g/100 g of fresh plant material, or depending on the hybrid, 60 to 125 kg of oil/ha. As a result, it is believed that four of these hybrids of monarda may have the potential of becoming commercial sources of geraniol, linalool, tymol, and carvacrol ; 1, 8-cineole, also known as eucalyptol, cajuputoal, 1, 8-oxido-p-menthane, or 1, 8-epoxy-p-menthane, occurs in numerous essential oils (4, 7).

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