

## SOME ORNAMENTAL PLANTS EXCRETING RESPIRATORY IRRITANTS

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Many people who suffer from seasonal inhalant allergy in other sections of the United States, come to Florida to escape from offensive pollens at home, inasmuch as airborne pollen grains are commonly declared to be the principal exciting cause of such respiratory afflictions, and change of regional residence has in many cases brought relief (7). However, some victims who migrate to South Florida find their condition worsened by unanticipated plant air-pollutants in this environment.

Lillian Beaman Fly, formerly Assistant Professor of Botany, University of Miami, once made a year-long survey of airborne viable mold spores of South Florida and an exhaustive, 10-year study of the distribution of potential allergenic pollens of this area. She also made a 3-year study, in cooperation with local allergists, of the comparative antigenicity of selected pollens and mold spores of South Florida. It became apparent to her that the mango tree (*Mangifera indica* L.) though a major cause of widespread respiratory difficulty when in bloom, has sticky, non-windborne (anemophilous) pollen. This is confirmed by the experiments of R. W. Lakhapai and P. K. K. Nair who carried out a "Survey of the Atmospheric Pollen at Lucknow," India, "over a period of one year commencing from 1 October 1954." In their words, "The pollen were caught daily on a microscope slide smeared with glycerine jelly and exposed to the atmosphere at a height of about 25 ft. above the ground level. . . . One surprising fact is that although *Mangifera* is a very common tree in Lucknow, not a single pollen grain of this plant was trapped . . ." (14).

The mango tree is a member of the Anacardiaceae and accordingly related to poison ivy and poison sumac, and the sap and other parts of the tree and the peel of the fruit are common causes of dermatitis and even more serious reactions. Particularly sensitive individuals suffer swelling of the eyelids, facial burning and rash through proximity to blooming trees without direct contact (17). It seems logical to assume

that the inflorescence disperses into the atmosphere a substance, possibly similar to the urushiol of poison ivy, affecting the skin and the respiratory passages of many persons. Not only allergists but general practitioners treat many patients for respiratory difficulty during mango-blooming season (particularly January-February-March) in South Florida. The subdividing of some mango groves into homesites is bound to bring more hypersensitive individuals and blooming mangoes into juxtaposition.

In 1957, Mrs. Fly took preliminary steps to trap and study the offensive emanation from the mango bloom, but lack of financial support for such research prevented her pursuing it.

Since 1954, I have devoted much effort to the collection of evidence concerning human reactions to plants in South Florida. During these years, I have investigated numerous complaints from individuals experiencing respiratory trouble and a number of these problems I have traced to proximity to the mango tree at blooming time. Other complaints, however, have led directly to the related Brazilian pepper tree (*Schinus terebinthifolius* Raddi). The inhalant effects of this plant range from sneezing and severe sinus congestion, to acute headache. The elimination of the tree has removed the difficulty in known instances. Dermatitis as well as eye-inflammation and facial swelling are common complaints of those who trim the tree when it is in bloom or those who repeatedly trim a non-blooming hedge of this species. Crushed berries from sprays used for indoor decoration have caused severe respiratory irritation. I have received calls from baffled mothers of children who play beneath the tree or climb it and then suddenly exhibit symptoms usually associated with head colds or the early stages of "flu." The tree was formerly unsuspected in this area as an allergenic plant and it is not reported as such in the literature except in Burkill's *Dictionary of the Economic Products of the Malay Peninsula* where I found a reference to it as a cause of inhalant allergy. He says, "The pollen produces irritation enough to cause hay fever" (4). Yet this is based on misunderstanding, for this pollen, like that of the mango, is sticky and scarcely windborne. It is unfortunate that Bra-



Figure 1.—When in bloom, the Brazilian pepper (*Schinus terebinthifolius*) is a common source of respiratory irritation and dermatitis. The pollen is not windborne.

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zilian pepper, under the misnomer "Florida holly," became a common dooryard ornamental long in advance of realization of its harmful effects.

It has caused so much suffering that I shudder when I reread Dr. Henry Nehrling's words of praise in Volume I of the 1944 edition of *My Garden In Florida*: "The honor of having introduced this brilliant berry-bearing shrub belongs to Dr. Geo. Stone, an extremely busy physician and a passionate plant lover. While residing at Punta Gorda, about 18 years ago, he raised many hundreds of the Brazilian Pepper Trees from seed he had obtained somewhere from Brazil.\* He distributed these seedlings freely among his friends and plant lovers, and many were planted out along the city streets. While strolling along one of these thoroughfares the writer was struck by the unique beauty of a fine specimen in full fruit. He collected quite a number of the berries, from which all the specimens in his Naples garden have sprung. . . . It ought to be in every garden in Florida." He tells of the robins and cedar-birds gorging themselves on the berries in midwinter (21). Ralph Thurston says he has watched robins feed on the fruits until they seem intoxicated and unable to fly.

\*According to U. S. Dept. Agric. Inventory No. 1 of Foreign Seeds and Plants Imported, three packages of seed (P. I. No. 1760) were received through Mr. W. T. Swingle, Dec. 1898; Inventory No. 7: Mr. Swingle sent seeds (P. I. No. 3308) donated by Dr. Trabut, Government Botanist of Algeria, March 1899; Inventory No. 10: seeds (P. I. No. 7539) sent from Paris by Vilmorin Andrieux & Co., Sept. 1901.

They then seek water, if available, and resume feeding gluttonously.

The dispersal of the seeds by birds has been responsible for the escape of this noxious species into outlying districts of both south and central Florida.\*\* It now covers thousands of acres and, as residential developments are extended into these areas, it will become a much greater factor in respiratory ailments. In addition, its aggressive growth, overwhelming native vegetation, is now causing much concern among naturalists. In the words of Richard Klukas, Management Biologist of the Everglades National Park, it "harbors great potential for destruction of natural areas in southern Florida" (13). It is well on its way toward becoming the dominant species in Cape Florida State Park on Key Biscayne.

Another exotic tree with a similar threat to the Everglades is the constantly-multiplying cajeput (*Melaleuca quinquenervia* S. T. Blake, formerly known as *M. leucadendron* Linn.f.). I discussed this tree as a respiratory irritant in a paper, "The Cajeput Tree — a Boon and an Affliction," published in *Economic Botany* in March 1966 (19). With this tree, too, the problem is not one of windborne pollen but of volatile emanations and it is particularly troublesome when planted right outside a bedroom window. Adverse reactions are so common that the Florida Board of Forestry and the office of the Governor are receiving protests during the main

\*\*Homestead Boy Scout Troop 445, engaged to take an actual count, tallied 4,200 seedlings in a single 20-acre field.

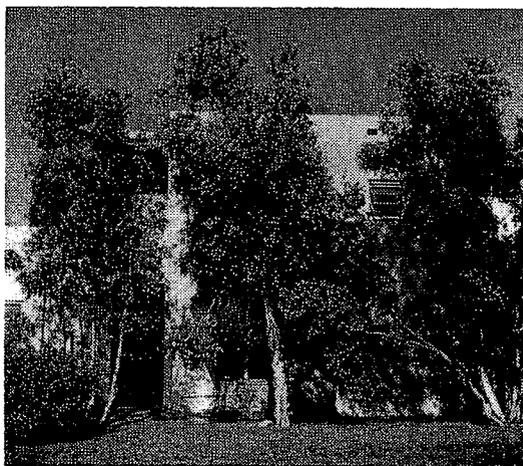


Figure 2.—Cajeput trees planted close to buildings produce asthma-like symptoms in sensitive individuals.

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blooming season of October and early November (5). Some individuals who have been overexposed to the flowering tree have respiratory difficulty in its proximity even when it is not in bloom. It is conceivable that the aromatic oil in the foliage — the cajeput oil used as a stimulant, rubefacient, etc., in medical practice — is vaporized by sunlight, or during certain stages of the tree's growth or foliage development, sufficiently to act as an irritant in the absence of bloom. The refined cajeput oil contains 40 to 65% cajuputol or cineol, identical to eucalyptol. Allergists are aware that many patients react to eucalyptol.

A number of physicians are now treating their cajeput-sensitive patients successfully with an extract of the entire flower cluster, either home-made or obtained from a commercial source. Over the past four years, I have had cajeput leaves and flowers collected and dried and have shipped them, as needed to Dr. Hildebert Wagner of the Institute for Pharmaceutical Research of the University of Munich where he and his colleagues are attempting to isolate and identify the respiratory irritant.

It is well-known that the heavily fragrant, nocturnal exudation of the flowers of the night-blooming jessamine (*Cestrum nocturnum* L.) causes much misery. The far-reaching fumes of this plant may induce intense headache, nausea, dizziness, throat irritation or sneezing. While the irritating property has not been identified, it is known that the leaves of three other species of *Cestrum* contain chlorogenic acid (31) which Freedman and co-workers in Canada in 1962 described as an "important chemical sensitizer responsible for human respiratory allergy to certain types of plant materials" (8). In 1966, Layton, Panzani and Corse transferred the blame from pure chlorogenic acid to a non-diffusible allergenic contaminant isolated from chlorogenic acid (15).

Nausea, violent headache, weakness in the knees and even torpor may be produced by the powerfully aromatic blooms of the angel's trumpet (especially *Datura candida* Pasq. and *D. suaveolens* Humb. & Bonpl.) and the common chalice vine (*Solandra nitida* Zucc.). These fragrant subjects are notorious as poisonous plants and their effects when ingested are similar to those produced by atropine, but we lack knowledge of their volatile constituents.

Until recent years, there has been little gen-

eral awareness of the toxicity of cycads and no scientific notice taken of the role of cycads as sources of inhalant allergens. Plants of the primitive family, Cycadaceae, particularly *Cycas circinalis* L. and *C. revoluta* Thunb. are commonly grown as dooryard ornamentals in South Florida under the false name "sago palm" and there is increasing interest in the decorative value of other genera and species, some cycad enthusiasts developing large and varied collections. This is not the place to dwell on the toxic aspects of the seeds and other parts when ingested. Intensive study of their carcinogenic and neurological effects is going forward in governmental and university laboratories in this country and abroad. Of immediate concern to Florida homeowners is the distress created by the male cones when they make their appearance throughout our residential areas in the spring (and sometimes in the fall). The odor is not only repulsive but irritating to the throat and respiratory passages. It has been the custom of gardeners to lop off the male cone as soon as it becomes offensive and dispose of it out of olfactory range. When this is not done in communities where the plants are popular, there may be wholesale aggravation, and many distress calls to local newspapers. A suffering lady in Surfside last May desperately sought a city ordinance to require the removal of male cycad cones in her vicinity. More recently, I have been contacted by a mother whose 4-year-old child was afflicted with an uncontrollable cough at night which defied the remedial efforts of physicians until the cone of a nearby male cycad disintegrated.

In the case of cycads, the pollen is windborne and the pollen of *Cycas circinalis* is reported in India as narcotic. Benthall, writing of *Cycas rumphii* Miq. in *Trees of Calcutta*, says: "In the hot weather, the young cones of male plants are quite orange in colour and very ornamental but their pollen has an unpleasant smell and is apt to cause violent sneezing" (3). In U. S. Public Health Rpt. 77, 615, 1762, *Conference on the Cycad*, it was reported that, during the husking of the nuts of *Cycas circinalis*, a strong acrid odor may actually cause dizziness. The toxic agent in the nuts was then thought to be cyanogen or cyanide-releasing compounds. It is now identified as cyeasin. The pollen apparently has similar principles. Japanese scientists announced the finding of toxic azoxyglycosides in the male

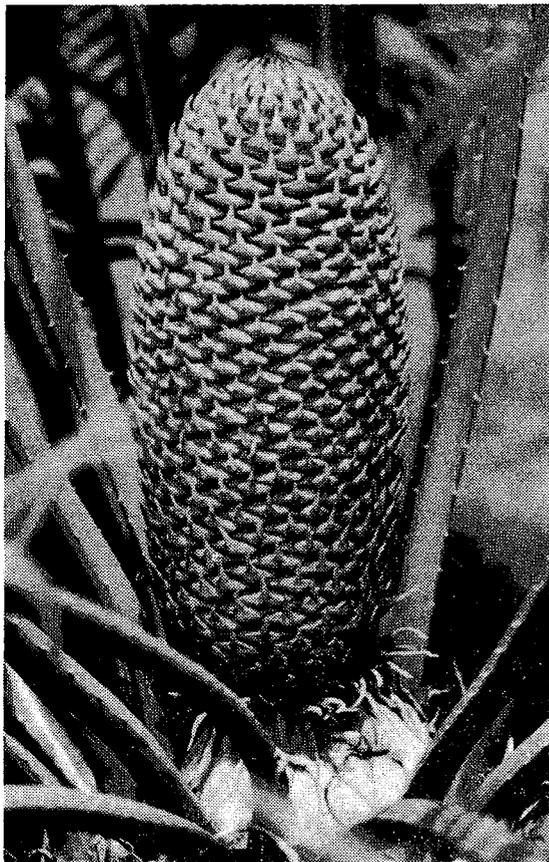


Figure 3.—The male cone of *Cycas circinalis* and other cycads gives off an offensive odor and windborne pollen, causing respiratory distress.

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strobile of *Cycas revoluta* in 1960 (22).

It is probably fortunate that the popular wax-leaf privet (*Ligustrum japonicum* Thunb.) is nearly always trimmed as a hedge in South Florida, for the very similar *Ligustrum vulgare* L., which is allowed to bloom freely throughout much of the southern United States, is said to produce respiratory symptoms in persons within its immediate vicinity, though *Ligustrum* species are not classed among sources of windborne pollen (7).

Allergists in the past have been prone to discount their patients' association of symptoms with plants the pollen grains of which have not been found in the air. However, chemists have disclosed identical compounds in both anemophilous and entomophilous (insect-borne) pollen (18). Sverchkow in the Ukraine has studied the

effect on air ionization of volatile aromatic excretions of plants during flowering and points out that some plants such as bird cherry (*Prunus padus* L.) and fragrant tobacco (*Nicotiana* spp.) exert a hygienically unfavorable effect (28). All parts of the bird cherry contain cyanogenetic glycosides.

In Western Australia, asthmatic people suffer when in contact with the silky oak (*Grevillea robusta* A. Cunn.) at any season of the year (20). That respiratory irritants are not limited to floral parts, is further evidenced by the hay-fever-like reactions experienced by some Florida residents when a hedge of *Vitex trifolia* L. (20) or even the popular Surinam cherry (*Eugenia uniflora* L.) is trimmed; also when Christmas trees are shipped into this area and displayed in the pre-holiday period. The odor of the garlic vine, *Pseudocalymma alliaceum* Sandw., most pronounced during and after rain, is seldom a cause of complaint. However, Eric Golby, Manager of Reasoner's Tropical Nurseries, tells of two workmen trimming a massive specimen on a house in Sarasota who had to give up after a half-hour, overcome by volatile emanations which induced coughing, gagging and severe facial burning and swelling.

It was formerly assumed, by allergists and



Figure 4.—Trimming hedges of *Vitex trifolia* L. and var. *variegata* Moldenke releases potent aromatic substances into the atmosphere.

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others, that strong odors merely competed with the victim's oxygen supply. Violent aversions to certain plant odors, such as that of *Paederia foetida* L. which has at times caused loud protests from residents near the Dade County Nursery, have been attributed to personal idiosyncrasies. Rumors of harmful vapors from plants have been relegated to the realm of superstition by authors of recent books, though it has long been common knowledge that aromatic emanations from onions being peeled or sliced irritate respiratory passages and induce tears, and volatile exhalations from the lemon-scented gas-plant, or burning-bush (*Dictamnus albus* L.) of temperate-region gardens will ignite if a lighted match is held beneath the flower cluster in the evening when the air is still and sultry (2).

Burkill records that the smell of the herb, *Ocimum sanctum* L., widely known as holy basil, and in Malaya as *selaseh*, "is unpleasant and causes giddiness; hence the Malay expression 'as intoxicated as from selaseh'" (4). Two years ago, I received a letter from a botanist with the U. S. Dept. of Agriculture who had just returned from an assignment in India. He wrote: "*Daphne cannabina* literally covers whole hill-sides above Darjeeling — at elevations of 10,000 ft. and above. During May, when it is in full flower, it has a profound anesthetic effect on some people passing near or through dense populations of it." (12).

Not sufficient credence was given the discussion of "Scents of Plant Origin" in the 2nd edition of the textbook, *Allergy*, by Urbach and Gottlieb, published in 1946, and it was dropped from subsequent editions. The authors stated that "Clinical and experimental evidence proves that odors can act as inhalant allergens in certain cases. . . . Aromatic substances are characterized by their volatility and strong odor, and belong to the group of ethereal oils. The ethereal oil is usually composed of a variety of compounds, many of which are still unidentified. Most of them are derivatives of terpene ( $C_{10}H_{16}$ ), but nitrogenous substances such as anthralin acid esters, indole, skatole, and mustard oils are also frequently found. It has been assumed that the latter group may be especially significant in cases of hypersensitiveness" (30). It is appropriate to inject here a note from my file that one local plant enthusiast suffers asthma-like symptoms when pulling up *Peperomia pellucida* H.B.K., a weed with strong, mus-

tard-like odor.

Notorious for their horrid smell are the insect-pollinated flowers of the Bangar nut, or so-called "wild almond," *Sterculia foetida* L., an Old World species occasionally grown as an ornamental and curiosity in Florida gardens. In early spring when it is without leaves and in full bloom, it pollutes the atmosphere unbearably. D. V. Cowen, author of *Flowering Trees and Shrubs in India*, frankly states: ". . . the main characteristics of these flowers is their incredible stench. Coming across a Wild Almond in bloom, one's first thoughts would be that one was near an open sewer and many parts of the tree when bruised or cut emit this rank, unpleasant odour. . . . The malodorous nature of the tree is emphasized in its name — *Sterculia* being from a word meaning 'dung' and *foetida* meaning 'stinking!'" (6) Where there is so much scent there is also much substance. What unwholesome chemical may be assailing the senses of those exposed to these fumes? We know that the leaves, stems and roots of the tree contain hydrocyanic acid and *Sterculia foetida* oil, de-



Figure 5.—Flowers of the Bangar nut (*Sterculia foetida*) emit malodorous volatile oils. The seed oil has proved to be a co-carcinogen.

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rived from the seeds, acts as a co-carcinogen, enhancing the hepatocarcinogenic effects of aflatoxin in experimental animals (16).

In recent years, much progress has been made in widely scattered investigations of natural air pollutants. Rasmussen and Went (23) and Haagen-Smit (11) have demonstrated that terpenes given off in considerable volume from forests and desert plants contribute substantially to atmospheric haze. Schildknecht and Rauch, in Germany, isolated a phytonicidal, fungicidal and protistocidal principle in the black locust (*Robinia pseudacacia* L.) and found this substance to be given off by undisturbed plants of this species (26). Just a year ago, researchers Sawicki and Golden of the National Center for Air Pollution Control, in Cincinnati, Ohio, reported the discovery of atmospheric scopoletin — a hydroxylated coumarin in airborne particles of biological origin associated with allergies (27).

The reasonable person will no longer scoff at sincere claims that certain odoriferous plants are capable of producing real, not imagined, discomforts and actual illness. In choosing plants for landscaping, both in private grounds and public places, species apt to cause misery should not be located close to dwellings or other buildings and certainly not near windows. Even if windows are closed, some types of air-conditioners will draw plant fumes into the premises. And we should all, in the interest of the well-being of our State, lend our support to efforts to obstruct the spread of invasive noxious species.

As a precedent for action, one can point to the City of Atlanta, Georgia, where the Mayor in August, 1938, issued an order to the Sanitary Department to abolish all trees of *Ailanthus altissima* Swingle within city limits, in accordance with an ordinance that had been placed in the statutes more than 50 years before (10). This misnamed "Tree of Heaven" is a fast-growing species, multiplying by seeds and suckers, which has escaped from cultivation and become a weed-tree in and around many cities in the Midwest and the northeastern United States. It has been the subject of much grievance because the objectionable odor of the male flowers is irritating to the throat and eyes. The leaves also are disagreeably odorous and often a cause of dermatitis. A British botanist, describing seedlings in a greenhouse in 1756, wrote that the "foliage developed an odor so intensely disagree-

able that he frequently got headache and a sickness at the stomach by remaining too long near it" (29). It is amazing that a tree as obnoxious as this is still widely promoted as an ornamental. I have several times received calls from local people attracted by advertisements proclaiming its rapid growth and hoping to cultivate it in the Miami area. One lady planted four in her yard on Anderson Avenue in Coral Gables and assured me in 1963 that one was doing well. Happily, this one has since died, for the new owner of the property, who has been afflicted with an undefined eye and nasal allergy for some months, has sufficient cause for aggravation in the presence of a mango tree, a silky oak, also *Vitex trifolia* and a gigantic castor bean, all within a few feet of her back door.

Any part of the castor bean (*Ricinus communis* L.) may produce severe asthmatic reactions in sensitive individuals. There have been many outbreaks of bronchial asthma among workers in castor oil factories, individuals exposed to the crushed beans becoming more and more sensitive to them (24). In time, a sensitized person will react to an amount invisible to the unaided eye. The seeds were formerly used for dissection in elementary Botany classes but have been abandoned because it was found that even one in a laboratory could cause a sensitive person to react with severe respiratory irritation, sneezing, headache and eye inflammation, together with facial swelling (25). Four years ago, I received an appeal for information from the Royal Infirmary in Aberdeen, Scotland, when a 17-year-old girl experienced difficulty in breathing and other acute allergic reactions after swallowing a seed from a castor bean necklace, and subsequently a girl in the Miami area reacted similarly, but more mildly, merely from handling a necklace made of these seeds. Dr. H. L. Arnold, in *Poisonous Plants of Hawaii*, states: "The writer has observed an almost fatal anaphylaxis in a woman tourist a few years ago from biting into one bean" (1). The presence of this powerful allergen, in addition to the other toxic properties of the castor bean, should be sufficient reason to discourage the planting of the red-leaved and other ornamental forms of this dangerous plant in home gardens, and full advantage should be taken of any opportunity to eliminate the plant where it has run wild. It has been, quite wisely, outlawed in several counties in California.

It seems that there should be in Florida some means of controlling the dissemination of superfluous species that affect the health of at least a significant portion of the populace. The plight of the allergy sufferer is pathetic enough and the allergist works against dreadful odds in endeavoring to pinpoint causes of agony. Generally, extracts supplied by laboratories for testing and treatment are those of grasses and weeds which have proved allergenic in other parts of the United States but which are rare or absent in this area. Mysteries abound.

Though we are only beginning to learn the identities of inhalant allergens excreted by ornamental plant materials, we should be willing to admit that air pollution by plants is FACT rather than FANCY and we should take steps to avoid ruining our own environment by harboring and permitting the increase of major sources of respiratory irritants. Scientists everywhere are disturbed by our increasing exposure to chemicals in modern society. Not the least of these, to my mind, are those in the many aerosol products used in the home. In certain cases, it has appeared that some sprays are more apt to be irritating to the eyes or respiratory passages where sensitivity has been priorly developed by overexposure to inflammatory excretions from plant sources.

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