

Contact Dermatitis From Sonoran Desert Plants

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In 1965, dermatologists around Poona on the west coast of India suddenly began to see agricultural workers with a skin eruption affecting their faces, necks and forearms. Initially, the skin was erythematous and later became wet with exudate and covered with fluid-filled vesicles. The affected skin itched intensely. Sometimes the eruptions became generalized over a wide area. The damaged skin was susceptible to bacterial invasion (impetiginization) and these patients also suffered fatigue and weight loss. Some patients developed a universal erythroderma unresponsive to treatment with systemic corticosteroids and a few died. More generally, the skin lesions progressed to a chronic state in which the skin appeared thickened. It became fissured and developed plaque-like structures so that the skin surface resembled tree bark (lichenification). Children did not share the susceptibility to this plant exhibited by adults.

By 1968, the cause of the scourge was shown to be the weed feverfew, *Parthenium hysterophorus*. Feverfew, a common name shared by other plants, is native to the southeastern United States, to the Rio Grande plains and southeastern Texas, most of Mexico, the Caribbean, Argentina and Bolivia. It was first noted in Poona in 1956, where it is presumed to have been introduced as a contaminant with cereal grains from the western hemisphere. It became established rapidly, crowding out the local flora, and establishing itself over hundreds of square miles throughout India. Efforts toward eradication are viewed as increasingly hopeless. In one desperate attempt, 2,500 school children were mobilized to go into the fields and pull up the weed.

The skin reactive materials in *Parthenium hysterophorus* are sesquiterpene lactones, the pseudoguainolides parthenin and ambrosin. These chemicals are formed and stored in trichomes and capitate sessile glands on the leaf surface where they presumably function as insect-feeding deterrents. Allergic contact dermatitis results from the deposition of these chemicals on to the skin of sensitized individuals. It is not even necessary to go into the field to make contact, since there is an abundance of trichomes on wind-blown plant fragments that can affect city dwellers.

The disastrous affect of this alien invader in India is of considerable interest since a plant of the same genus, *P. argentatum*, the guayule or rubber plant, is being introduced from its native homeland of Trans-Pecos Texas and the Chihuahuan Desert into the Sonoran Desert regions of Arizona and Mexico to be grown commercially as a source of isoprene rubber. It, too, contains a dermatitis-evoking sensitizer, in this case guayulin A, a cinnamic acid ester of a sesquiterpene alcohol. It is as potent as parthenin, or in terms more familiar in the United States, as poison ivy and poison oak. Plant breeding experiments are in progress to develop plants with good commercial characteristics. Guayule undergoes hybridization with mariola, *P. incanum*, of Arizona and Sonora, and *P. tomentosum* var. *stramonium*, an arborescent species of Sonora and Sinaloa. Both of these species also contain sesquiterpene lactones that produce allergic contact dermatitis and are cytotoxic. The potential health hazards that may result from the introduction of this alien plant or from a genetic variety are yet to be determined. Guayule has already escaped from cultivation and is becoming established in the Sonoran

Desert.

In man, contact dermatitis is the most deleterious form of plant injury in terms of the number of people affected, the degree of suffering, and economic loss. Plants capable of damaging the skin are under-reported from desert areas simply because of the low population exposure. Obviously, it is useful to determine which plants may be injurious so that if they appear in new geographic areas or are of interest for agricultural exploitation, appropriate measures can be taken to minimize any potential hazard. To encourage the reporting of plants not previously associated with der-

matitis, we have selected the Sonoran Desert and will utilize its endemic species to illustrate the varieties of contact dermatitis. In many instances, the injury-producing plants are not noted in the medical literature and we owe our knowledge of many of them to Dr. Robert H. Peebles, who included this information in Kearney & Peebles *Arizona Flora*. A note on methods for reporting plant dermatitis appears at the end of this article. Unless otherwise stated, all Mexican common names will be specific for the State of Sonora. Care should be exercised, however, in using common names for identification, since



Sapindus saponaria var. *drummondii*

Sapium biloculare

the same name may be applied to many plants not related botanically but which share the property for inducing dermatitis.

Allergic Contact Dermatitis

This type of dermatitis requires sensitization to a plant by cutaneous contact. Only on a subsequent exposure can dermatitis be elicited. The sensitizing substances are low molecular weight compounds (haptens) that penetrate the skin to combine with epidermal protein to form antigens. More than one contact with the hapten may be necessary to induce sensitization. There is considerable difference in the ability of various haptens to induce sensitivity, some producing this state in most individuals after a single contact, others require multiple challenges and then sensitize only a small portion of the population. About one to three weeks are required after the sensitizing contact for the required immunological changes to occur in the body before another contact with the plant can result in dermatitis. Some haptens produce a transient sensitivity lasting only for a single season; others may induce lifetime sensitization. Sensitization is relatively specific. Individuals sensitized to poison ivy, for example, will be affected by other dermatitis-producing members of the Anacardiaceae since there are only small differences in the structures of their haptens; however, they will not respond to dermatitis-producing plants of other families since they contain haptens of unrelated structure.

Once the individual becomes sensitized, the entire skin surface becomes reactive. However, only that part of the skin that actually comes into contact with the plant will exhibit dermatitis. Some body sites, particularly the palms and soles, where the horny layer of the skin (stratum corneum) is thickest, and the hairy scalp, are less likely to exhibit dermatitis because these present a physical barrier to the hapten.

Following re-exposure of the sensitized individual, a 12- to 24-hour period, sometimes more, elapses before the dermatitis appears. This latent period is the distinguishing feature for the classification of allergic contact dermatitis. Individuals who have had previous cases of dermatitis from the plant or are exposed to massive amounts of hapten tend to exhibit shorter latent periods. The first detectable response is reddening of the skin, sometimes accompanied by edematous swelling. During the following 24 hours, blisters (known as vesicles or bullae, depending on size) form. These are filled with serous fluid which is antigen-free and cannot spread dermatitis to other areas of the body or to other individuals. Such spread is due invariably to hapten remaining on unwashed hands or that has contaminated clothing or equipment. Exudation may be marked so that the affected areas will be quite moist. Severe itching is a consistent and diagnostic feature of this type of dermatitis. Sensitized individuals show a wide range of responsiveness to a measured quantity of hapten, some exhibiting only a mild erythema whereas others can show a disabling dermatitis. In addition to this difference between people, the severity of the response is determined also by the quantity of hapten, as well as the size and region of the skin involved. The eyelids and scrotum are particularly sensitive and respond with severe edematous swelling but generally do

not exhibit the formation of vesicles. In the absence of continued exposure or complications from mechanical irritation (scratching), infection, or inappropriate treatment, crusting and scaling will begin in a few days and the dermatitis will clear in about ten days.

The *Parthenium* described in the introduction produces this type of dermatitis. A number of Sonoran Desert plants producing allergic contact dermatitis are known. The poison ivy family requires considerable moisture so it is restricted to canyon walls near rivers or springs. Across the southern three counties of Arizona and throughout the state of Sonora, this family is represented by poison ivy, *Toxicodendron radicans* var. *divaricatum*. Poison ivy is known by a member of common names throughout Mexico, including mala mujer, hiedra venenosa, and, from its tendency to produce marked swelling of the scrotum, as hinch huevos. Poison oak, *T. diversilobum*, occurs only in the Baja California portion of the Sonoran Desert, where it is known as hiedra or hiegra. It is distributed sparsely in Baja California, but extends at least as far south as Mission El Rosario. It is likely to become more abundant, as it has in California, as a result of land clearing and changes in fire frequency, but will still be limited from low moisture.

Phacelia, in the family Hydrophyllaceae, is another genus that produces allergic contact dermatitis. The hapten is contained in a stinging hair (trichome). Nine of the ten known sensitizing species of *Phacelia* occur within the Sonoran Desert. The most familiar is the desert heliotrope, *P. crenulata*, known in Baja California as rama zorilla (skunk bush). It also occurs in the State of Sonora, in Arizona and in California. This plant possesses the most potent hapten of the *Phacelia* species tested. Interestingly, these haptens are highly specific, so that those with differing sidechains may not elicit cross-sensitivity. In addition to *Phacelia crenulata*, Sonoran Desert members of this genus that produce dermatitis are: *P. campularia*, *P. pedicellata*, *P. minor*, *P. parryi*, *P. ixodes*, *P. brachyloba*, *P. grandiflora*, and *P. viscida*.

Other allergic sensitizers are the copperweed *Iva acerosa* (*Oxytenia acerosa*), a member of the Asteraceae. This is a relatively potent sensitizer. Two very weak and therefore infrequent sensitizers are the creosote bush, *Larrea divaricata* ssp. *tridentata* (gobernadora), a member of the Zygophyllaceae, and the common mesquite, *Prosopis glandulosa* (katzimelk), a member of the Fabaceae.

Irritant Dermatitis

Certain plants contain substances that are irritant or corrosive to the skin. The response is indistinguishable by gross appearance from allergic contact dermatitis. It may be differentiated in that the skin damage appears shortly after exposure and that the reaction is not accompanied by intense itching. Most individuals presumably would react to these chemicals, although various anatomical regions do differ in sensitivity, primarily because of differences in the thickness of the stratum corneum. In contrast to the experience with allergic contactants, children's skin is more susceptible to damage from direct irritants than that of the adult. There is no consistent difference in response between men and women, but there seems to be some genetic variation in respect to the severity. No immunologic

mechanism is involved, however, some sensitizing hap- tens, particularly phenolics, also are direct irritants if the skin is exposed to a sufficient concentration.

Most often associated with this type of injury are members of the Euphorbiaceae. In the classification of G.L. Webster (*Taxon* 24:593-601, 1975), plants contained within the subfamily Euphorbioideae, which includes the genus *Euphorbia*, exude a whitish latex when cut that is often caustic to the skin. This latex may contain tiglane, ingenane, or dapnane diterpenes. These polyhydroxy tricyclic and tetracyclic hydrocarbons are of interest not only because they are inflammatory to the skin, but also because some can act as co-carcinogens, that is they promote the action of 'sub'-carcinogenic dose of known carcinogens. Almost all studies have focused on members of this genus from Africa and little is known of the toxicity or chemistry of New World species.

If the latex comes in contact with the eye, there is an immediate burning sensation accompanied by copious tearing and sensitivity to light. During the subsequent eight to twelve hours, the vision becomes blurred and the pain increases. The epithelium of the cornea is corroded and there is marked edema and congestion of the conjunctiva. The eyelids will be reddened and edematous. The stromal layer of the cornea becomes edematous and this change leads to loss of visual acuity or blindness. The cornea appears whitish and opaque. Depending upon the extent of the initial injury, the stromal edema recedes over one or two weeks and the vision becomes restored without adverse sequelae.

Stillingia, which is a member of the same subfamily, is well-represented: *S. spinulosa* occurs in sandy desert soils of the Lower Sonoran Zone, Baja California, and southwestern Arizona; *S. paucidentata* in sandy and gravelly desert slopes of the Lower Sonoran Zone, southern California, and barely enters Arizona at the mouth of the Williams River between Yuma and Mohave counties; and *S. linearifolia* in washes and sandy flats in central Baja California, southern California, western Arizona, and into northern Sonora. Nothing is known of the toxicity of these plants, although two eastern species, both present in Texas, *S. sylvatica* and *S. texana* have a milky white latex with vesicant properties.

Sapium biloculare belongs to a genus that is morphologically related closely to *Stillingia*. This large shrub is distributed southward from Maricopa County in Arizona into the desert areas of Sonora and Baja California. It has a number of common names, including Mexican jumping bean (more commonly applied to *Sebastiania pavoniana*), hierbe de la flecha (Baja California and Sonora), hierbe mala, magot, and hehe-coanj (all Sonoran). All the Mexican species of this genus are reported to have a vesicant latex. Smoke from the burning wood of this species is reputed to produce severe eye irritation.

The Sonoran Desert species of *Manihot*, which belong to a different subfamily (Crotonoideae) of the Euphorbiaceae, are said to be injurious to the skin; however, no details have been published and there is an absence of reports on dermatitis for the many tropical members of this genus.

Saponins are glycosides of triterpenoids or sterols that are present in a great number of plants. Sometimes their con-

centration is so great that mixing plant tissue with water produces a foam and such plants have been used in early societies as laundry soap and to kill fish. Prolonged handling of the fruits of *Sapindus saponaria* var. *drummondii* (Sapindaceae) can result in irritant dermatitis. This tree, known as the soapberry in Arizona and mata muchacho or chirrion in Sonora, has a translucent amber berry, about one-half inch in diameter, that may contain up to 30% saponin.

The only representative of the Plumbaginaceae in Arizona is *Plumbago scandens*, which occurs at 2,500 to 4,000 feet in canyons in Pima and Pinal counties. It is found also in Baja California near the coast from Loreto south into the cape region, and it is common in all but the driest parts of the desert in Sonora. It is known generally as hierba des pescado and as canutillo in Sinaloa. The leaves, stems, and particularly the roots are vesicant, a property exhibited by other members of this genus. The chemical responsible is plumbagin, 5-hydroxy-2-methyl-1, 4-naphthoquinone.

The sap from some agaves, for example *Agave parryi* and *A. americana*, can produce a severe burning sensation within three minutes. This is followed shortly by erythema and edema. Within hours, vesicles and exudation occurs. Diffuse splattering of the skin by the sap produces a hemorrhagic purpuric appearance, which develops over a 12- to 24-hour period. This may be accompanied by fever and malaise.

Phytophotodermatitis

A small number of plants, most of which are members of the carrot family (Apiaceae) or rue family (Rutaceae), contain furocoumarins (psoralens) that sensitize the skin to long-wave (UV-A) light. The skin penetration of the furocoumarins is enhanced by moisture so that many of the early descriptions mention wet leaves or bodies moistened by sweating as a requisite for dermatitis. Within six to 24 hours of contact, and following exposure to sunlight, the exposed skin area burns. This can range from a mild erythema to severe blistering. Presumably all exposed individuals will be affected. After the burn clears, the affected skin becomes pigmented and may remain so for many months. Sometimes precise leaf patterns can be seen as dark tattoos on the skin.

The only phytophotodermatitis-inducing plants in the Sonoran Desert area are the hop tree, *Ptelea trifoliata* ssp. *angustifolia* in Arizona, *P. aptera* in Baja California, and two unidentified species of *Ptelea* on the fringes of the desert in Sonora.

Contact Urticaria

Contact urticaria is a response to plants characterized by a stinging or itching sensation, usually associated with the formation of a smooth, elevated patch on the skin (wheal). The wheal may be redder or paler than the surrounding skin. This response from plants may be either nonimmunologic or allergic, but the former is more common.

Nonimmunologic contact urticaria is typically produced by the stinging nettles. These plants have fluid-filled hollow hairs (trichomes) that act as hypodermic needles, penetrating the skin to release their contents. This causes an almost immediate burning sensation associated with

itching. *Urtica dioica* var. *gracilis* (ortiga) occurs in Arizona and Sonora. *U. urens* (chichicaste) is sparingly naturalized from Europe throughout the area. Another member of the Urticaceae, present in Baja California and particularly noted for its "vicious, stinging hairs" is *Hesperocnide tenella*. The chemical details are unfortunately lacking. It has been suggested that acetylcholine, histamine, and serotonin are present and responsible for the observed reaction. However, this notion is based on tissue assays and has not been confirmed by chemical analysis.

Certain members of the Euphorbiaceae also possess stinging hairs that can produce prolonged and severe responses. A selected member from each genus in the Sonoran Desert would include *Dalechampia scandens*, *Tragia amblyodonta*, and *Cnidoscolus angustidens*. The *Tragia* exhibit considerable differences in sting severity between different members of the genus; the one cited is very potent. *Dalechampia* species produce the least severe response, possibly because any given plant may possess few or no stinging hairs. *Dalechampia* and *Tragia* are both



Cnidoscolus angustidens



Cissus trifoliata



Cnidoscolus angustidens



Parthenium argentatum

members of the subfamily Acalyphoideae; *Cnidocolus* is in the subfamily Crotonoideae. For none of these has the chemistry of the stinging hairs been reported. In the case of *Cnidocolus*, a large molecular weight component is suggested since painful tenderness and swelling occurs in distant superficial lymph nodes following anything more than minor contact. Although proteases have been isolated from the leaves of some species and triterpenoids from the latex, the contents of the trichomes apparently has not received chemical attention.

Only four families are known to have stinging hairs and all four are represented in the Sonoran Desert area. The first, the Hydrophyllaceae, represented by *Phacelia*, was discussed under allergic contact dermatitis. The Euphorbiaceae and Urticaceae have been discussed in this section. The last of the four, Loasaceae, is well represented by three genera with stinging hairs. A selected representative from each would be *Gronovia scandens* (quemador), *Eucnide urens*, and *Cevallia sinuata*. The relative intensity of individual species (there are five species of *Eucnide* in Baja California alone) has not been reported nor has the stinging component of any of the Loasaceae been determined.

Mechanical Injury

Desert plants are often well-armed with thorns, spines or barbs as a strategy of assuring their survival. In Kearney and Peebles *Arizona Flora*, the devil's claw or cat claw acacia, *Acacia greggii*, is described as: "This is probably the most heartily disliked plant in the state, the sharp, strong prickles tearing the clothes and lacerating the flesh." Although a vast number of plants could be described in this respect, two are of particular interest.

A single genus of cactus, *Opuntia*, (cholla, prickly pear), possesses detachable, barbed bristles (glochids). The ocular implantation of windborne glochids may produce eye irritation, which sometimes will not resolve unless they are removed mechanically. The imbedding of glochids in the skin, at least in Arizona, may lead to allergic granulomas. This phenomenon is not encountered elsewhere in the United States. It is ascribed to contamination of the glochid surface with a fungus, specifically the dry climate organism *Alternaria*. Since this organism acts as a source of hapten, only individuals who have become sensitized will respond with a granuloma to injury from the glochid.

Any type of thorn can act as a vector for introducing bacteria. A thorn broken from the plant and lodged near bone over a prolonged period acts as a foreign body that may induce osteoblastic or osteolytic responses visible by X-ray and known as "thorn tumors". Thorns lodged in joints may be responsible for synovitis. "Thorns" in the form of calcium oxalate needles may occur within the plant, either in

the leaves and stem or in the fruit. *Cissus trifoliata*, a member of the grape family (Vitaceae) acts in this manner as a simple, but severe mechanical irritant.

The most recent report (1985) describing a dermatitis-producing plant from Arizona is the coast fiddleneck, *Amsinckia intermedia*. This plant is covered with short, stiff bristles that can result in a rash through mechanical irritation. Although this response has been noted for other members of the Boraginaceae, it is the first report for this genus.

How to Report Dermatitis-Producing Plants

Plants not previously noted to produce allergic contact dermatitis, contact urticaria, primarily chemical irritation, or phytophotodermatitis should have this information published. The easiest source to determine whether such a report has already been made is the encyclopedic reference by Mitchell and Rook: *Botanical Dermatology*. Although the publication of this information in a botanical serial or book will be disseminated eventually to dermatologists and public health workers, it would be highly desired if such notes were inserted into medical publications directly. Two outlets are recommended for brief notes: any State Medical Journal or the journal *Contact Dermatitis*. The latter will publish brief notes of two or three paragraphs.

It is hoped that this article also has indicated certain gaps in our information concerning plants already known to be injurious, e.g., the comparative irritant potential of the Sonoran species of *Stillingia*. The incorporation of such information in monographs or floras is of much value to economic botanists and health professionals.

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