# A GUIDE TO COLLECTING PANDANACEAE (*PANDANUS, FREYCINETIA,* AND *SARARANGA*)

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The family Pandanaceae is paleotropical and consists of three genera, *Pandanus* L. ex Stickm. with the most species (over 600) and the widest distribution, from W. Africa eastward throughout the tropical areas to the Pacific Islands; *Freycinetia,* with about 180 species and the next largest distribution, from Ceylon (but not India, except the Andaman and Nicobar Islands) eastward through the Malesian area into the Pacific and New Zealand; and *Sararanga,* a restricted small genus of two species, one in the Philippines and the other in New Guinea and the Solomon Islands.

All species of *Freycinetia* are woody lianas; among these there occur some relatively large plants, with stems reaching perhaps 6–7 cm diameter and leaves of perhaps 150 cm length and a width of perhaps 10 cm; but most species are rather smaller and some are really quite small plants, the extreme perhaps being *Freycinetia elegantula* with leaves only 2–3 cm long. Both species of *Sararanga* are arboreous, branched, with rather massive leaves 200 cm long or more, and erect trunks. They have, unlike all other pandans, compound paniculate inflorescences that are pendulous and may be well over 100 cm long. The genus is readily recognized by its quadrifarious spiral phyllotaxy, and concomitant square-section inflorescence rachises. The flowers and fruits are also unique in the family, the latter being irregularly globular many-seeded berries. The true pandans, *Pandanus* species, have a rather wide range of form and size, with tall arboreous plants such as *Pandanus antaresensis* of New Guinea, which may reach 33 m height and have massive proproots 10 m long and 20 cm thick, at one extreme, and diminutive shrubs such as *Pandanus herbaceus, P. toei,* or *P. unguiculatus,* which have short slender stems reaching at most 2 m height, and 2–3 cm or less in diameter (and in examples such as *P. toei,* are cespitose with little stem development) at the other extreme. Besides these examples, pandans have developed into epiphytic shrubs, some with a pseudo-lianous type of growth, others cespitose and "stemless" and most of these are small shrubs, although one species (*P. epiphyticus*) is, apart from its reduced stem, quite massive.

The family is important in several regions wherein it has developed a high degree of endemism and contributes to the fundamental structure and physiognomy of the vegetation. In other regions its presence is limited to coastal areas. Only in the Philippines, New Guinea, and the Solomon Islands can all three genera be found occurring together. Outlying posts of the family include New Zealand, which has only *Freycinetia,* and only one species; and Sao Thomé Island (off Angola, W. Africa), where one species of *Pandanus* occurs. Central areas of endemism are Madagascar, which has only the genus *Pandanus* but about 100 endemic species; Thailand, which has both *Freycinetia* (but only two or three species) and *Pandanus,* the latter with perhaps over two dozen species; Malaya, with eight species of *Freycinetia* and about fifty of *Pandanus*; Borneo, with two dozen species of *Freycinetia* and more than fifty of *Pandanus*; the Philippine archipelago, with about the same numbers of both genera as Borneo; New Guinea, with probably about 60 species of *Freycinetia* and 70 or more of *Pandanus*; the Solomon Islands, with about 23 species of *Freycinetia* and 28 species of *Pandanus*; and New Caledonia, with about 14 species of *Freycinetia* and 21 species of *Pandanus.* Some important secondary centers include Australia, especially Queensland, with only four species of *Freycinetia* but a somewhat richer *Pandanus*-flora (possibly 15–20 species); Fiji; Mauritius; the Seychelles; Burma and the Himalayan foothills; Sumatra; and East Africa. Besides these, several small regions have one or a few local endemic species, usually of *Pandanus* to the exclusion of the other genera; examples are Lord Howe Island, Christmas Island (Indian Ocean), Hainan, etc.

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## MORPHOLOGY

Basic habit has been described above. In all species, the leaf is simple, usually more or less elongated, often long linear-attenuate, but (mostly in *Freycinetia*) sometimes subelliptic to ovate. The margins of the leaf are usually denticulate, as is the midrib on the undersurface. In *Pandanus* (only) many species also have teeth (spinules, aculeations, denticuli, prickles) on the upper (ventral) leaf apex, along the two pleats; their presence is a major taxonomic character and is a principal reason why good, intact material of leaf apices must be present in all pandan collections. The size, spacing, form, color, and other details of the leaf teeth are also of taxonomic importance. In *Freycinetia,* the leaf-sheath is elaborated by the presence of a pair of auricles, which are membranous flanges of the leaf-base; these are more or less distinct and taxonomically significant, and careful attention to obtaining good specimens is required. In *Pandanus,* such auricles are almost always lacking but a few species possess them and in any case good complete leaf-bases are a requisite for adequate representation in the herbarium. As the leaves are often very large (in a few cases, up to 9 m long and 21 cm wide), it is often impossible to collect more than a few. In fact, most herbarium material consists of a single leaf, or less, except in the case of very small plants such as *Pandanus herbaceus.* The collector must attempt to represent leaf variation in his collection. (Methods are described below.)

The trunk and proproots may furnish some taxonomically useful data, but are often either not collected, or may be difficult and bulky. Slabs of wood, with bark, from the main trunk, can be obtained, and segments of proproots. Certainly the habit, the branching pattern, and development, if any, of proproots should be noted in the form of sketches or photographs. In *Freycinetia,* aerial roots are either clasping or feeding (axillary); proproots (rigid ones) are not produced. Nor are there proproots in the *Sararanga* species. Epiphytes commonly produce feeding axillary roots.

The inflorescences are invariably terminal. However, they may terminate a normal leafy shoot, or a specialized lateral or axillary shoot. The latter differ from normal leafy shoots in possessing a reduced number of ordinary leaves, or in lacking such leaves, while bearing the usual scale leaves and bracts, and show the normal 2-ribbed prophyll at the base. Species of *Pandanus* and *Freycinetia* may have such lateral inflorescences (examples include *P. danckelmannianus* and *P. halleorum,* and *F. funicularis*). Therefore it is very important for the collector to represent, preferably by means of the collection itself, the inflorescence position. If this is impossible, drawings or photographs should document it. The inflorescences of *Sararanga* are always terminal.

The construction of the inflorescence varies with the species. However, all may be described as a branched or, rarely, an unbranched, spadix. The most important consideration is the strict unisexuality of the plants; a given individual is male or female and can therefore bear only one sexual kind of inflorescence. *One of the most important tasks of the collector, therefore, is to attempt to obtain both male and female inflorescences of any particular species.* Unfortunately, this is by no means easy. Staminate material is poorly represented in herbaria; but correlated staminate and pistillate materials judged or proven by the collector to represent the sexes of a single species are even rarer. Isolated staminate collections in themselves are useful, but may be unidentifiable. On occasion, they may (and have) represented unknown species, and some have been described and designated as type specimens. However, since the whole taxonomic system is based upon characters of the pistillate plants, such species are often fascinating but frustrating and may remain "incertae sedis" or even "nomina dubia" until the females are discovered. The role of the staminate material is however becoming increasingly important as more is learned of the micromorphology and anatomy, and in some cases can already be of critical significance in taxonomy; but good collections are still rare. One reason is the difficulty of locating staminate inflorescences. As flowering is seasonal in most pandans, while fruit development is a lengthy process, there is a much higher probability of finding pistillate trees with partly developed fruits, than there is of finding staminate specimens with fresh flowers at anthesis. The duration of a staminate inflorescence is usually only one to three days; while the flowering season may only be a week or two. In contrast, fruit development may take several months. Phenology of flowering in the pandans is still poorly known. However, there are certainly several patterns already in evidence. In some cases (*Pandanus fragrans*) flowering may be approximately every other month. In other cases, flowering may be at intervals longer than one year. Many species are probably gregarious with synchrony in flowering, but the period may be very short. Robert Tucker in Queensland has reported that annual flowering in *Pandanus conicus* and *P. tectorius* is highly concentrated in a two-week period, with in fact most anthesis taking place in the same week. Much of the rest of the year, the plants appear to be sterile, except those that are gestating fruits. Such patterns of flowering mean that collectors often encounter flowering pandans at random and by chance, and find ripe flowering materials very much less commonly than unripe, or even ripe, fruits. However, it should be remembered that if staminate individuals are seen to be in flower (they are usually the more obvious, as the inflorescences are more lax and pendulous, and the white or colored spathes are noticeable), then it is highly likely that searching will reveal pistillate plants in the same locality also in flower. Such searches are of the greatest importance in linking staminate with pistillate collections to establish full knowledge of a species. But a caution must be noted: there are many localities in which several species of the same genus are sympatric and intermixed, and extreme care must be taken to establish *vegetative* similarities of the sexes. The danger of attributing flowering male and female plants to the same species, but in fact having material from males of one species and females of another, is quite serious.

The staminate inflorescences are spikelike. Usually, there are several spikes, each with an axillant bract, from the main rachis. In a few cases, the inflorescence is reduced to a single, apparently terminal spike, though there are always several bracts. (The bracts are sometimes called spathes, though they are quite different from anything in the Araceae.) Each spike bears staminate flowers. They are naked, devoid of perianth, almost always without bracteoles. Each staminate flower consists of a small or large aggregation of stamens, and there is a considerable variation of form; the stamens may seem to be separately and individually attached to the spike rachis, or be borne in small or large clusters on short or long axes (usually called columns or stemonophores). Pollen is often copious, but is dispersed quickly and also quickly ingested by the ubiquitous insect fauna of the inflorescences, which seems always and everywhere to include Nitidulid beetles and thrips, supplemented by roving, predatory earwigs. Pollen consumption is rapid and unless the collection is made early in anthesis and is quickly and adequately preserved, most of the pollen will be turned into frass and larvae. Numerous herbarium specimens of staminate collections now serve only to show floral form (if that), and lack pollen. Pollen characters are proving to be taxonomically useful, so care should be taken to preserve pollen in the specimens. If the collector has the facilities, liquid (FAA or just formalin) collections of staminate spikes should be obtained as supplementary to the dried material. The same is true of early stages of anthesis of female inflorescences.

The female inflorescences may also be simple or compound. If one applies this terminology to the gynoecial pattern of the flower, the same difference obtains. Consequently one may recognize four types of pistillate inflorescences; (a) with a single spike (head, or cephalium) formed of 1-carpellate flowers; (b) with several spikes formed of 1-carpellate flowers; (c) with a single spike formed of polycarpellate flowers; (d) with several spikes formed of polycarpellate flowers. In cases (a) and (c), the inflorescence is described as "solitary." This is the normal state in many, but not the majority, of *Pandanus* species, but is quite rare in *Freycinetia.* In cases (b) and (d), the inflorescence is "spicate" and this is the usual case in *Freycinetia,* and quite common in *Pandanus.* In *Sararanga,* as already mentioned, the massive inflorescence is always a richly-branched panicle.

In *Freycinetia,* the spikes (both male and female) tend to be closely adjacent and often ternate, so that the open ripe inflorescence seems to be an umbel. In a few cases (*F. angustifolia, F. jagorii*) the inflorescence is racemiform, as it is in nearly all species of *Pandanus* in the males, and in many species also in the females.

The bracts provide some useful characters, particularly as to color. On an inflorescence there is a spectrum of bracts, those at the base virtually leaflike, those subsequent each more altered, by the reduction of the length and the spread of the lower, colored part, until even the extreme apex is colored rather than green. The base is usually broadly expanded and boat-shaped, and the texture thinner or, especially in *Freycinetia,* actually thicker but much softer. In *Freycinetia,* the uppermost bracts are quite modified, becoming (in the apt phrase of Paul Cox) "solid bat nectar," i.e. soft, sugary, and entirely palatable. This does not occur in *Pandanus,* in which all bracts still retain a certain (if thin) stiffness. (The bract texture in *Sararanga* is unknown.) As the inflorescence ages, the bracts wither and many drop off or remain as tattered brown shreds and wisps. In *Freycinetia,* only a few basal bracts are retained and in ripening fruit these finally fall; most of the upper (visually, inner) bracts by this time have long since been eaten (around anthesis) or rotted away (later). But in *Pandanus,* the intermediate bracts usually wither and dry (turning brown) but remain in place on the ripening fruits; or, in the staminate inflorescence, dry up. The staminate rachis becomes fleshy and rots quickly, so that the inflorescence tends to break up as, or before, it falls. As already stated, this process is very rapid, taking only a few days, hastened by rapid chewing up of the softer parts by the local fauna of the inflorescence. In short, the collector usually only sees the full array of bracts in material at or before anthesis; and the colors are best, or only, visible then. The color, size, and details of the bracts afford a rather important means of correlating male and female of the same species; not that bracts of the two sexes are exactly alike, but they will be substantially similar. Naturally, collectors' observations on fauna, including possible pollen or seed vectors, will be of great value.

The fruits provide the most depended upon, readily observable, and preservable characters for identification. The components of the infructescence, besides the bracts and the rachises, are the heads (cephalia), or syncarps as they are sometimes called; this term however is rather ambiguous, as it can also be applied to the aggregate drupes, also termed polydrupes or phalanges, which are the main component units of the cephalium in those species which have them. In other species, with simple (1-celled) drupes, the term is not ambiguous but as it has been used for both cases, I prefer to abandon it and use the clearer term cephalium (or head). In any case, the cephalium, the drupe or phalange; and the details of each, provide numerous important taxonomic characters. It is almost essential, however, that the fruit be fully ripe. A great deal of confusion has been caused by unwary taxonomists unaware of relative states of maturity in dried specimens. This has led to "paper species" created on the basis of "false" characters, e.g. phalange dimensions. Unripe fruits also lack the critical mature coloration which can prove valuable taxonomically. On the other hand, well-preserved (particularly liquid-preserved) collections of young *flowering* pistillate material are highly desirable. However, when dried, this is sometimes so altered in aspect, lacking in useful marks, and in interior features, that it may be unidentifiable. Just as it is important to correlate male and female specimens, it is important to correlate fruiting with flowering pistillate collections.

In the drupes or phalanges, the style and stigma is of crucial importance taxonomically. In some species, these structures are either fragile (in many, they can be easily abraded or broken off), or they are severely altered by the drying process. In such cases close observation and sketches or sharp close-up photographs may preserve information later lost.

The leaves, apart from gross morphological data, provide a wealth of useful taxonomic information in their micromorphology. Data from anatomical and scanning electron microscope studies have shown that highly significant additional and correlative information can be extracted from a small sample of a leaf. However, this has to be based on a standardization. For such studies the sample must be: a segment of the leaf, about 1–3 cm long (i.e. along the leaf long axis), and including both margins, i.e. a complete median segment; or in large leaves or with minimal materials, a segment including one margin and the entire midrib, but omitting the other margin, will ordinarily suffice. This sample must be taken from a fully adult leaf, midway in the prophyll-leaf spectrum (i.e. representing the series of longest leaves). It must also be from an adult shoot (not a "sucker-shoot" or a flowering shoot with reduced leaves). And it must be from an adult plant, not a seedling or "sapling." In most cases, sufficient micromorphological data can be obtained from such segments removed from herbarium specimens, but it is more difficult in such cases to be sure that the standardization criteria have been met; hence, suitable leaves taken in the field might well be marked specially "*for anatomical study.*" (Anatomists using herbarium material would appreciate this.)

Separate pollen collections (preserved or thoroughly dried and disinfected) are highly desirable, as a great deal of pollen is lost through the usual drying techniques when making herbarium specimens.

Correctly labelled liquid-preserved specimens of heads or partial heads at anthesis are highly useful in the interpretation of stigmatic structure and this supplementary collecting is strongly urged upon collectors who have the means available. (If FAA is lacking, strong alcohol or just formalin may suffice.)

## Field Collecting Methods and Sampling

Small pandans of either *Pandanus* or *Freycinetia* can often be treated as any other plants, as whole branches with attached leaves, inflorescences or infructescences, and sometimes part of the root system, may be small enough to fit in standard size drying papers. Where inflorescences and infructescences are concerned, however, the advisability of providing supplementary liquid-preserved collections must be emphasized.

For bigger plants of any of the three genera, some careful sampling has to be done. Where the leafy stems are more than 2–3 cm in diameter, they can be split longitudinally. Such a method is helpful in reducing the thickness of specimens but has the disadvantage of cutting through the spiralled leaves in such a way that useful characters of the leaf-bases may be damaged or lost. Therefore, what is always required in such cases is the separate preservation of carefully detached leaves dried separately. They should be removed so that the whole sheath is intact (especially with auriculate *Freycinetias*); they can be folded back and forth, accordion-style, to fit into the drying papers. The tips of these leaves should be intact also; if they are naturally broken or abraded, each such leaf should be supplemented by a tip from another leaf so that the form, dentation, etc., of the complete apex is present. Unripe leaves from the center of leaf-crowns may provide such tips, but (because of basal growth) cannot provide adequate leaf-base and sheath or auricle characters. In *Freycinetia,* the auricles can best be sampled by carefully stripping away a series of leaves (older ones first) until the leaf-bases of leaves with fresh (i.e. not dried or withered) auricles are in view; these leaves should then be removed by circumferential shallow slicing, and preserved individually.

In *Pandanus* and *Sararanga* the adult leaf-bases are often very rigid and inconveniently large; they can be flattened readily if they are dried as separate halves (longitudinally divided). In species with very long leaves, leaf-length measurements can be supplemented by standard leaf segments; in such cases the segments have to be numbered or lettered sequentially so they can be "reassembled" later for study. The collector has to make a pragmatic decision about how many leaves to collect; since each herbarium specimen may consist of one leaf, or less, and still be so bulky as to spill over onto two or more sheets, it is especially important that the collector provide careful and logical sampling techniques in the field. A choice of organs [prophyll, some scale leaves, some transitional bracts, fully-formed bracts, etc., as well as fully adult leaves, immature leaves, "sucker-shoot" leaves, and (when possible) seedlings] must be made so that a fuller knowledge of both leaf structural and dimensional variation, and age and developmental variation, is preserved inherently in the specimens. It cannot be overemphasized that such careful sampling techniques can be disrupted when duplicate specimens are sorted out and distributed; if at all possible, the bulk of the collection, or the most representative, should be re-

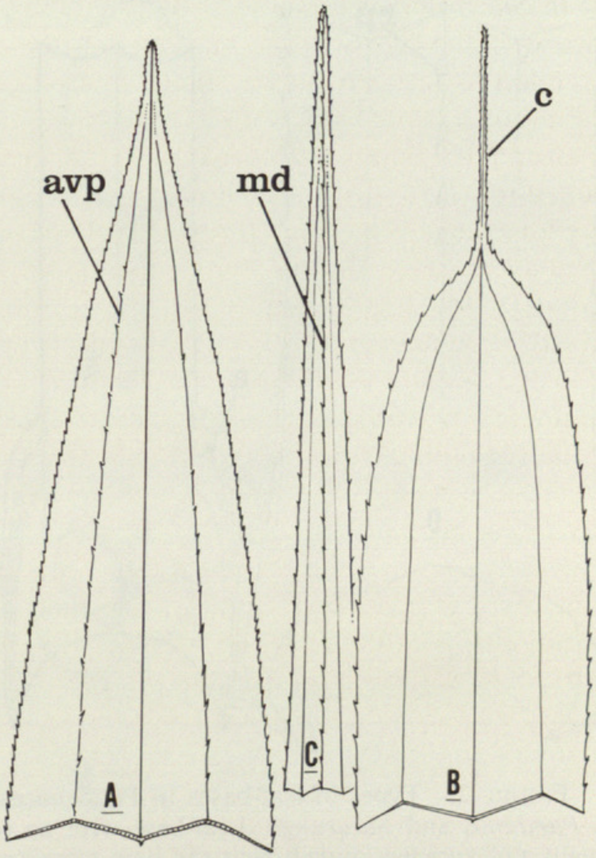


Figure 1. Types of leaf apices in Pandanaceae. A. Upper (ventral) surface of a species of *Pandanus* with denticulate apical-ventral pleats (avp). B. Upper (ventral) surface of a species of *Pandanus* (or *Freycinetia* or *Sararanga*) lacking denticulations on the apical-ventral pleats. C. Lower (dorsal) surface of a leaf apex showing the armed midrib. All the denticulations are antrorse.

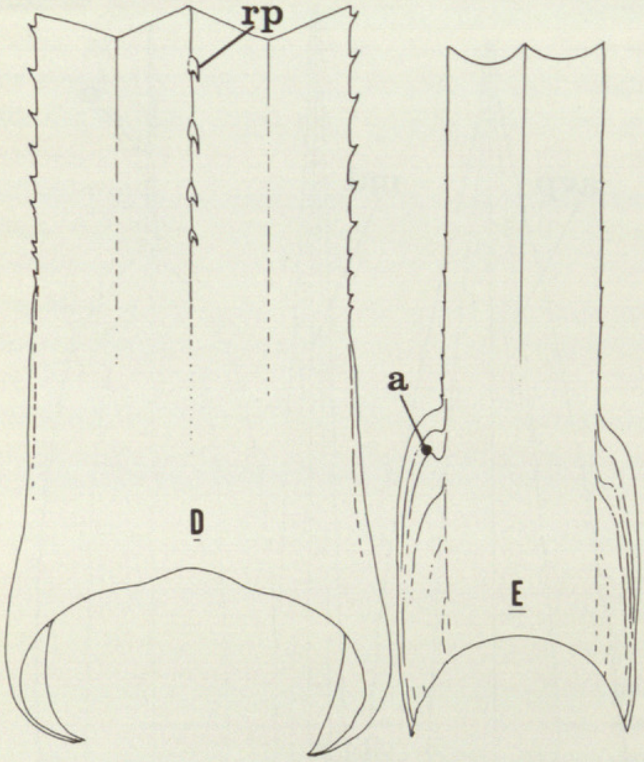


FIGURE 2. Types of leaf-bases in Pandanaceae. D. *Pandanus* and *Sararanga*. Leaf-base with no (or usually no) auricles; midrib near the base often (not always) armed with (often) recurved (retrorse) prickles. E. *Freycinetia*. Leaf-base with auricles (a), and unarmed basal portion of midrib.

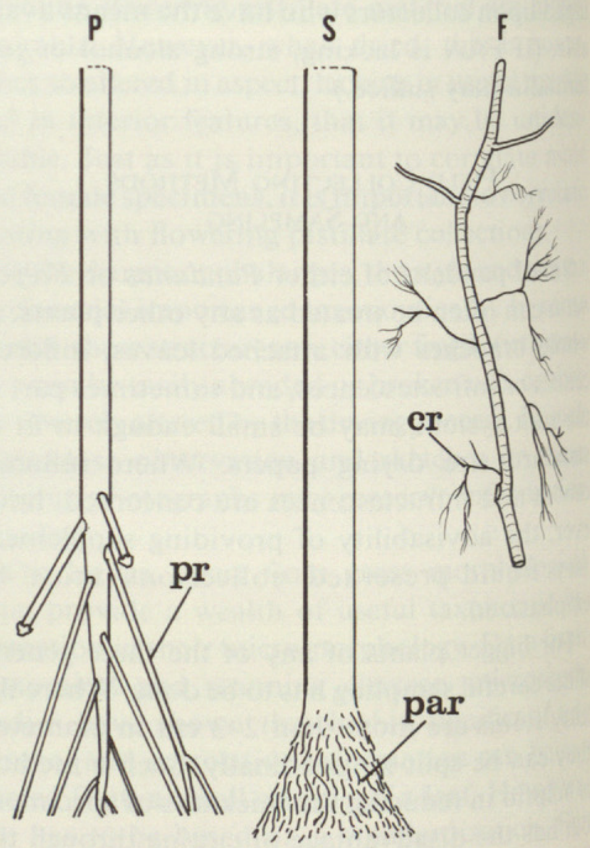


FIGURE 3. Habit in Pandanaceae. P = *Pandanus*, erect trunk, proproots (pr). S = *Sararanga*; erect trunk, palmoid roots at base (par). F = *Freycinetia*; climbing stem with clasping roots (cr).

tained until taxonomic study is completed. Duplicate specimens often appear which contain (for example) one prophyll, three phalanges, and a single leaf apex; needless to say, the form and the important diagnostic features of the plant cannot possibly be represented by such an aggregate of parts.

The goal of sampling should be to represent all possible organs and structures in such a way that a part, supplemented by notes, drawings, and photographs, can provide an accurate notion of the entirety. But this goal is more difficult when it comes to the whole habit of the plant, more so when variation in a population is found. However, thoughtful consideration of this problem usually results in some functional *ad hoc* technique that works fairly well. The question of *intra-population* variability is, at least in some species or complexes, a serious matter, which needs intensive study, in view of the sometimes drastic differences in taxonomic points of view expressed by different botanists concerned with the same species or species-groups. Thus, collection of a series of individuals (all, of course, carefully correlated and separately numbered) within a pragmatically determined population is a specific kind of collecting activity which is becoming urgent, particularly in such critical species as the *Pandanus tectorius* complex, the species of *Pandanus* sect. *Austrokeura*, the *Pandanus odoratissimus* complex, the *P. furcatus* complex, and certain groups of *Freycinetia*.

## COLLECTING TOOLS AND EQUIPMENT

(1) A strong, sharp *parang* or *machete* or bush-knife; for very large specimens, a hatchet may also be useful.

(2) Pruning shears or sequiteurs.

(3) Thick gloves (pandans are always spiny and ready to attack).

(4) Field notebook.

(5) String tags (jewellers' tags). These are really necessary especially when leaves etc. are segmented sequentially. A small stapler is also helpful.

(6) Pencils and (preferably) India-ink pens; the latter are extremely useful for labels to be placed in liquid-preserved material.

(7) Plant presses—the usual materials.

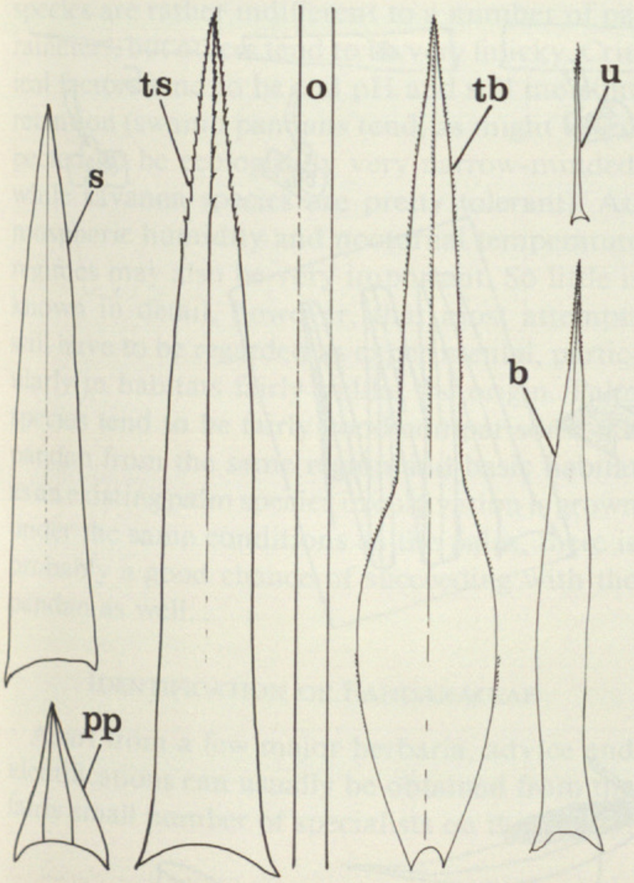


FIGURE 4. Leaf spectrum in Pandanaceae. Example drawn from a species of *Pandanus.* pp = prophyll (note twin costae). s = scale leaf. ts = transitional leaf (intermediate between scales and normal foliage). O = zone of normal foliage leaves. tb = transitional (inflorescence) bract; apex green and leaflike, base softer, expanded. b = normal bract, entirely colored. u = ultimate bract. Inflorescence terminates shoot meristem growth; branching occurs from next lower axil, the first organ to appear being the prophyll. Sequence repeats.

(8) Liquid preservative supply.

(9) Bottles and vials for liquid-preserved specimens.

(10) Powder-form fungicide (especially for pollen collections).

(11) Camera and film supply.

(12) Sketchbook (if additional to field notebook).

(13) Plastic bags.

(14) Cordage (string or nylon).

(15) Final labels.

## LIVING COLLECTIONS

Pandans of almost any species are desirable for collection as ripe seed, small germinating seedlings, or cuttings. There are few botanic gardens with good collections of the family [among

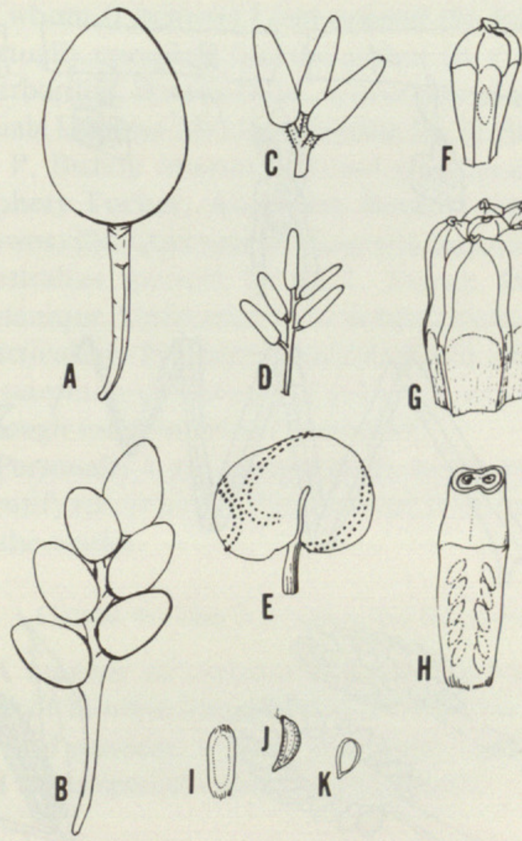


FIGURE 5. Types of inflorescence and fruit formation in Pandanaceae. A. Solitary cephalium. B. Spike of cephalia. C. Pseudumbel of (ternate) cephalia (*Freycinetia*). D. Raceme of cephalia (*Freycinetia*). E. Polyspermous berry of *Sararanga* (black dots are stigmas). F. Simple drupe of *Pandanus.* G. Polydrupe = phalange of *Pandanus.* H. Berry (bicarpellate, multiovulate) of *Freycinetia.* I. Pyrene of *Pandanus.* J. Seed of *Freycinetia.* K. Seed of *Sararanga.*

these may be mentioned first those tropical gardens that have outdoor collections, e.g. Bogor, Singapore, Kuala Lumpur, Lae, Peradeniya, Calcutta, Lucknow, Amani (? present status unknown), Fairchild, Tsimbazaza (Madagascar), Foster Garden and Pacific Tropical Botanic Garden, Hawaii, Sydney, Townsville, and Cairns; and those which have above average indoor collections, examples being Kew, Munich, and perhaps some others]. Even old established gardens tend to have very few species and frequently only one individual of a species (which, as they are unisexual, tends to be lost in due course). *Pandanus* seeds tend to be fairly long-lasting and, wrapped in moist sphagnum, can be airmailed almost anywhere and survive; germination tends to be a long affair. *Freycinetia* seeds tend to germinate more rapidly; little is known of their horticultural requirements. Except for the Lae Botanic Gardens, the genus *Sararanga* is (I think) quite unknown in cultivation; further distribu-

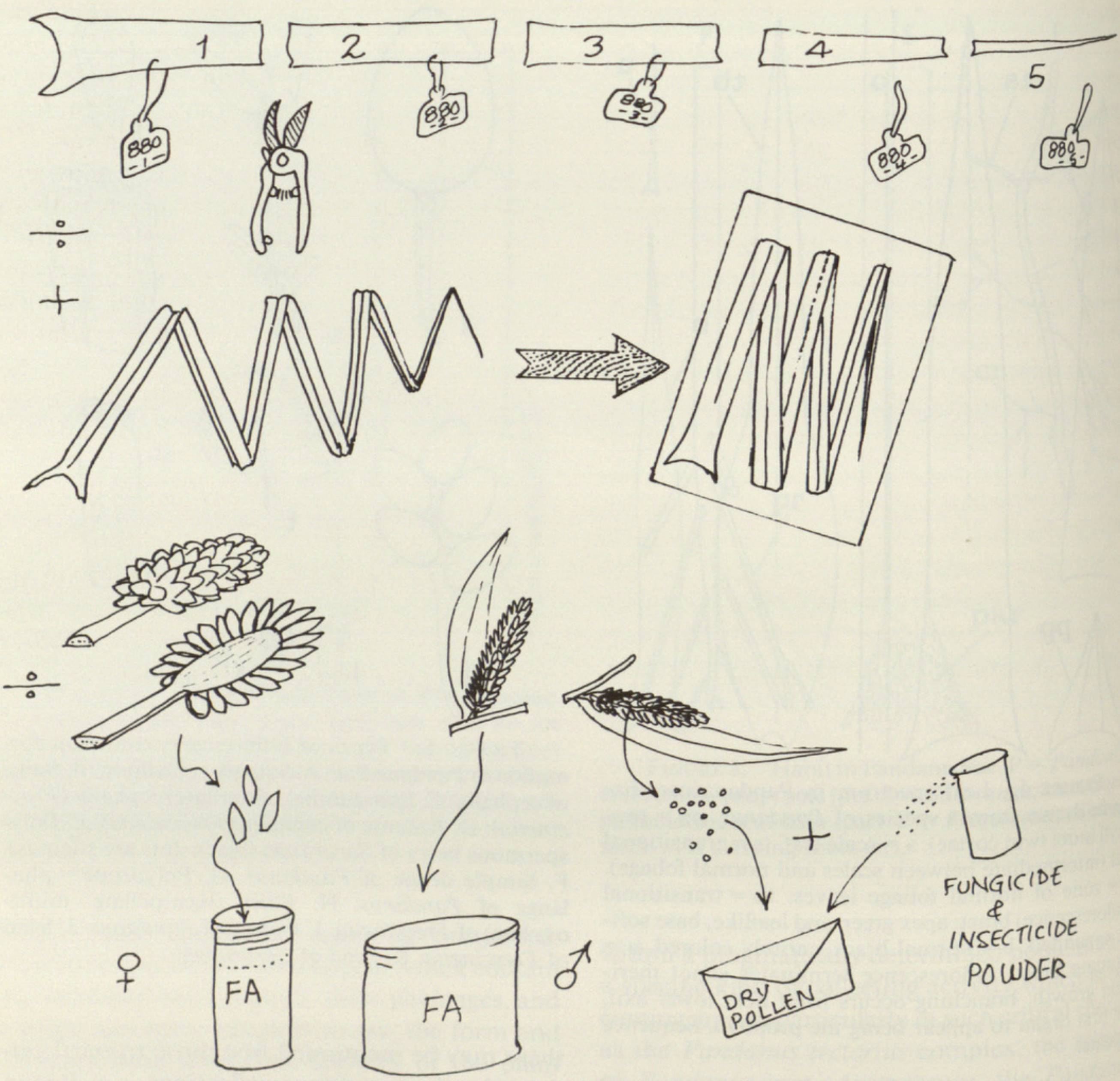


FIGURE 6. Some suggestions for collecting specimens of Pandanaceae. Above: large leaf, segmented, the segments numbered sequentially with both the collector's number and the leaf-segment number. Below this, a leaf folded back and forth *à la* accordion pleats to fit on the herbarium sheet. Below: fruit longitudinally divided and some of the phalanges or drupes preserved; staminate spike similarly divided, parts also preserved; pollen preserved in envelope with insecticide and fungicide powders. All treatments sequential to photography and note-taking.

tion, specifically of *S. philippinensis,* and of both sexes of both species, is highly desirable. The pandans in general tend to be horticulturally interesting and often curious or unusually elegant, and tend to cause considerable public interest. The species that are already comparatively well known in cultivation are few and can be conveniently listed here so collectors can (if they wish) avoid the slightly more elaborate task of collecting and distributing living material for propagation: *Pandanus tectorius, P. odoratissimus,* and most of the "horticultural" varieties of both of these (especially the striped, variegated leaf forms); *P. utilis*; *P. pygmaeus*; and *P. dubius* (known in horticulture as "*P. pacificus*"). The only freycinetias in cultivation tend to be *F. funicularis, F. multiflora* (of *F. cumingiana*), and *F. sumatrana,* and even these tend to be restricted to tropical gardens; nearly any *Freycinetia* is worth introducing to a botanic garden.

Environmental requirements for most species can only be deduced from natural habitat conditions, so the seed distribution should always include useful notes on these. Many pandan species are rather indifferent to a number of parameters, but others tend to be very finicky. Critical factors tend to be soil pH and soil moisture retention (swamp pandans tend, as might be expected, to be ecologically very narrow-minded, while savanna species are pretty tolerant). Atmospheric humidity and nocturnal temperature regimes may also be very important. So little is known in detail, however, that most attempts will have to be regarded as experimental, particularly in habitats fairly unlike the origin. Palm species tend to be fairly good comparisons; if a pandan from the same region and basic habitat as an existing palm species in cultivation is grown under the same conditions as the palm, there is probably a good chance of succeeding with the pandan as well.

## Identification of Pandanaceae

Apart from a few major herbaria, advice and identifications can usually be obtained from the fairly small number of specialists on the family, of whom (I believe) I can append the following virtually complete list: the author (B. C. Stone, Herbarium, Botany Dept., University of Malaya, Kuala Lumpur 22-11, Malaysia); Dr. H. St. John, B. P. Bishop Museum, Honolulu, Hawaii; Mr. Robert Tucker, Anderson Botanic Gardens, Townsville, Queensland, Australia (especially for Australian species); Dr. K.-L. Huynh, Institute Botanique, Université de Neuchatel, Switzerland (particularly for determinations based on sterile or staminate collections of unknown correlation, through microtechnical methods).

Personally I am always ready to receive and identify specimens of Pandanaceae from any part of the world.

## Guide to the Illustrated Section

A number of sketches are attached with the idea of familiarizing the reader with the basic parts of pandans, some of their gross variability, and some special collecting techniques.