



A Field Manual for Seed Collectors



**SEED COLLECTING FOR THE
MILLENNIUM SEED BANK PROJECT,
ROYAL BOTANIC GARDENS, KEW**

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INTRODUCTION

The Millennium Seed Bank Project International Programme

The Millennium Seed Bank Project (MSBP) International Programme is a nine year global conservation programme (2001-2010), conceived, developed and managed by the Seed Conservation Department at the Royal Botanic Gardens, Kew. The two principal aims of the Programme are to:

- Collect and conserve 10% of the world's seed-bearing flora (some 24,000 species), principally from the drylands, by the year 2010.
- Develop bilateral research, training and capacity-building relationships worldwide in order to support and to advance the seed conservation effort.

An integral element of the collecting programme is the development of collaborations with partner institutions all around the world. These partnerships have as their basis the precepts of the Convention on Biological Diversity, in which resources and responsibility are shared equitably by all parties through technology transfer, benefit sharing and capacity building. The MSBP currently (year 2001) has formal links with seed bank and conservation institutions in the USA, South Africa, Western Australia, Mexico, Chile, Madagascar, Egypt, Lebanon, Burkina Faso, Namibia and Kenya, and is in the process of developing partnerships in many other countries throughout the world.

The purpose of this manual

This Manual of Seed Collecting is part of the MSBP's information-sharing process, and is designed to provide general guidelines regarding seed collecting practice and to provide specific practical details relevant to the collection of seed for the MSBP. It is envisaged that this booklet will be used by the MSBP's own seed collectors and by MSBP collaborators if they wish. It is written with the understanding that different institutions and projects will have different priorities and protocols, which they may wish to adhere to, and is not meant to be the definitive guide to seed collecting. This booklet is therefore best regarded as a guide to the practice followed by the MSBP. This is a living document, which will be updated and expanded periodically, and it is hoped that our partners throughout the world will contribute to this process.

PLANNING A SEED COLLECTING EXPEDITION

Aims

The aims of the MSB collecting programme can be defined as the establishment of verified and well documented seed collections of wild species, each of which truly represents the genetic variation within the population from which it was sampled. The collections then act as a basis for conservation or, where authority has been given, as a source of material to *bona fide* institutes worldwide for all aspects of biological study.

The target established by RBG Kew for the Millennium Seed Bank project is the conservation of at least one population sample from 24,000 seed-bearing plant species, primarily from the drylands, that are not yet represented in the existing seed bank. Although a significant proportion of the genetic variation of many outbreeding¹ species can be adequately conserved

¹ Outbreeding: reproduction is most commonly achieved by cross-pollination, not self pollination.

in this way, it is hoped that this project will also form the basis for much wider future sampling across the genotypic range of these species.

Authorisation

Collecting permits

The Royal Botanic Gardens Kew honours the letter and spirit of the Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and other international, regional, national and sub-national laws and policies concerning biodiversity. RBG Kew is wholly committed to the principles of Prior Informed Consent (PIC) and mutually agreed terms. RBG Kew recognises the sovereign rights of states over their own biological resources and the authority of national governments to determine access to genetic resources, subject to national legislation. It also acknowledges the interests of other stakeholders, including indigenous and local communities and farmers, in biological resources and associated information. In practice this means that before any seed is collected, it is subject to PIC in the form of access agreements, permits from local authorities, and permission from land owners. For an illustration of RBG Kew's approach to these issues, including a model Material Acquisition Agreement between a Botanic Garden and a partner institution, follow links from the following Web site: <http://www.rbgekew.org.uk/conservation/index.html>

CITES

Seeds of all CITES Appendix 1 species, and seeds of Appendix 2 cacti from Mexico, are subject to CITES controls. In addition, dried herbarium specimens from all Appendix 1 and many Appendix 2 species are controlled. It is essential that the up to date CITES summary list is consulted before, during and after the expedition to ensure that no attempt is made to collect or to export controlled material without the relevant permits. Current lists of controlled taxa can be found in CITES publications or public web sites e.g. the UK CITES authority at http://www.ukcites.gov.uk/intro/cites_species.htm, and guidance for Kew staff is available on the internal web at <http://web/CAPS/notice.html>. The MSBP CITES liaison officer is Janet Terry, and non-RBG Kew staff should email her at j.terry@rbgekew.org.uk if they have any CITES related queries.

Plant Health

Phytosanitary permits are usually required for both the export of plant material from the country of origin and also for import into the UK. For exporting from the country of origin, the procedure is often specified in the Collecting Permit, and may necessitate separate application documents, a visual inspection of the seeds, and payment. Sufficient time should be allowed at the end of the expedition to follow this procedure. Where collected species are subject to phytosanitary regulations in the UK (Annex 1), a phytosanitary certificate should be obtained from the country of origin and presented, together with an RBG Kew letter of authority, to UK Customs. Material subject to phytosanitary regulations and destined for the Millennium Seed Bank should be sent to Janet Terry, Curation Section, Millennium Seed Bank Project, Wakehurst Place, Ardingly RH17 6TN, U.K. (email: j.terry@rbgekew.org.uk)

Prioritising species

The Millennium Seed Bank Project, working together with its partner institutions throughout the world, attempts to prioritise which plant species it collects and stores. The prioritisation criteria will vary from country to country depending on the partner's needs, but most commonly will include:

Orthodox seeds	i.e. Seeds which retain their viability after drying, and which are therefore likely to be bankable
Indigenous or endemic species	i.e. Species native to an area, and neither introduced nor a pan-tropical weed
Endangered, threatened or vulnerable species ²	i.e. Species of restricted distribution or threatened on a local, national or global scale
Economically important species	i.e. SEPASAL ³ species or otherwise valued/used by local people
Species suitable for research	i.e. Species targeted by RBG Kew/collaborator research projects
Seed not widely available	i.e. Seed not already in the bank or available through the List of Seeds or from commercial sources.
Rare seeds ²	i.e. Often difficult to find high quality or quantity seed of this species in this region

Identifying priority species before a field trip will usually involve a great deal of research. Not only will species have to be prioritised according to the various criteria above but, once selected, information will be needed on localities and phenology. It is essential to know when a species is likely to be in seed, and because of the uncertainties of the weather, this will vary from year to year. This means that herbarium data can only give the collector an estimate of when any particular species is likely to be in seed. Locality information on herbarium sheets may also be out of date. If possible, it is best to make contact with someone local who can provide up to date information on seeding and localities.

RBG Kew's Geographical Information System (GIS) Unit is currently exploring new methods of planning collecting trips, using information from herbarium sheets, digital maps and remote sensing data. It has already had some success in identifying habitats undergoing rapid degradation and which are therefore a priority for seed collecting expeditions (Almond, 2000). Further work will concentrate on using satellite data to provide real time information about phenology as a precursor to seed collecting missions. In addition, research into using environmental data to predict species distributions is ongoing (Sawkins *et al.*, 1999).

Tools and equipment

A checklist of tools and equipment necessary for a typical seed collecting expedition is given in Annex 2. Some key essentials are as follows:

Identification aids: Targeting of species is pointless if the plants can't be recognised in the field. Regardless of whether local expertise is available, floras or identification guides should be taken whenever possible. Where these are not available, photocopies of herbarium sheets make a good substitute. If opportunistic collections are to be made, identification tools will be needed in combination with an up to date seed list, a list of seed bank collections for the

² See Annex 5 for guidelines on collecting rare and threatened plants

³ SEPASAL = Survey of Economic Plants from Arid and Semi-Arid Lands

region, previous expedition reports and a list of SEPASAL species for the region. In this way, duplication can be minimised, and species can be effectively targeted in the field.

Field data forms: Many institutions will prefer to use their own field data forms. If not, an example of the Millennium Seed Bank Project's field data form is reproduced in Annex 3. To accompany this, the collector will need the key to vegetation types. Local maps may also be useful, although use of the Geographical Positioning System (GPS) will, in most cases, make the recording of details about maps unnecessary.

Collecting equipment: Equipment not covered in the checklist will include medical supplies and, depending on the destination, camping gear and extra collecting equipment such as protective clothing, secateurs and loppers.

COLLECTING IN THE FIELD⁴

Plant identification and herbarium vouchers

It is critical to the value of the seed collections that the species is accurately identified, thus collectors are requested to enter comprehensive identification notes on the field data form. If a local expert is not available to identify species, plant identification guides should be used instead. Floras are often incomplete and, in many cases, are more appropriate to herbarium identification. Most useful, where they are available, are local guidebooks with plenty of colour illustrations. Photocopies of herbarium specimens may also be useful for identifying target species. Where opportunistic collecting takes place, the collector will need to refer to the Seed List and an up-to-date list of species collected in the region, in order to limit the risks of duplication.

Quality herbarium specimens are valuable additional outputs of the collecting programme, and collectors are encouraged to take at least three representative herbarium specimens for each seed collection made (see below). Collectors wishing to learn the correct technique should either try to accompany an experienced botanist taking specimens in the field, or should try to attend a training session run as part of this project (see Table 1). Literature available to consult includes Bridson and Forman (1992). In the unlikely event that specimens cannot be taken to accompany a seed collection, RBG Kew is able to prepare a cultivated voucher from most taxa with the exception of large shrubs and trees. For these latter species, and where it is not possible to take herbarium vouchers, verification in the field by an acknowledged named expert will be sufficient for the needs of this project.

Table 1: Notes on good herbarium voucher collection (from Herbarium Techniques Course, RBG Kew).

NOTES

Good voucher specimens should be:

1. carefully selected plant material
2. well preserved
3. accompanied by an unambiguous collection number
4. accompanied by good collection data

1. Careful selection of plant material

Material should be fertile. Material should be representative of:

- population; collect all or range of phenotypes, or collect an average specimen and note range.
- individual - some of top, middle and base if not possible to collect whole plant:
 - Underground parts if possible
 - Bark/wood
 - Heterophylly (e.g. juvenile foliage with stipules)
 - Developmental stages (leaf buds, young leaves, flower buds)
 - Male and female flowers
 - Different flower forms
 - Points of attachment, i.e. preserve arrangement of organs
 - Loose collections useful. Place in capsule as extra material.

Use discretion regarding the amount of plant material to take – non-destructive sampling. Number of duplicates - 2 minimum; 5 ideal. GOLDEN RULE: Look at and plan sampling of plant before cutting bits off.

⁴ See Annex 5 for guidelines on collecting rare and threatened plants.

2. Well preserved

Araceae and fleshy parts in spirit

Palms and Pandanaceae bases of leaves important

Wax papers for delicate tissues

Details of special conditions for collecting and preserving plant parts in different families in Herbarium Handbook

3. Numbering

Good idea to produce book with numbers on it already in which to put your notes. Helps avoid danger of number duplication. Keep simple 1- X

4. Good collection data

Minimum:

- locality, including country
- altitude
- habitat
- description of plant - concentrate on things lost in sampling, e.g. smell, colours, life form, 3 dimensional structures
- collector's name
- collection number
- date of collection

NOTE: use of GPS co-ordinates can be a security risk in the case of endangered species

Additional data:

- name (e.g. vernacular)
- ecology (associated species)
- detailed morphological data (see below)
- frequency of occurrence
- economic data
- conservation status

Morphological data:

- habit/height/spread
- underground parts if not collected
- stems and trunks - buttresses, bark, latex etc.
- stipules
- fresh size, shape, colour of inflorescence, flowers, fruits, seeds

Voucher specimens should bear the same number as the related seed collection, and should ideally include flower, fruiting structure, vegetative parts and roots of annuals. Ideally the specimens should be dried daily using portable driers. Where this is not possible, the specimens should be kept warm and dry and the absorbent paper should be changed frequently. Within the constraints of the expedition and the permits granted, herbarium specimens may also be taken from significant species where no seed is available for collection.

The specimens will be forwarded by the collector, the project co-ordinator or RBG Kew, (as agreed locally), to local specialists, or other specialists recommended by RBG Kew for verification. RBG Kew will provide printed herbarium labels derived from the original field data to attach to the mounted herbarium specimens. Following verification, herbarium vouchers will be lodged in the following order of priority, firstly: the local herbarium responsible for the identification, secondly: RBG Kew Herbarium, thirdly: other local herbaria.

Targeting a population for sampling

Following identification of a target species for collection, the collector must decide whether the population⁵ is suitable for sampling. It is often helpful to make a preliminary visit to the site to assess the populations, to confirm the identification, to estimate the likely harvesting date and potential seed production. The most important factors in deciding whether to collect from a population are as follows:

- The population is likely to be genetically distinct (defined, for example, by soil, climate, altitude, pollinator's range, physical barriers to genetic mixing).
- The population has not already been adequately sampled and conserved by the seed bank(s).
- The population is wild, self-sown and not planted or cultivated.
- At least 50 individuals can be sampled randomly and evenly.
- 10,000 to 20,000 seeds can be collected within the time constraints. In practice, these quantities can often be achieved in less than two 'collector-hours'.
- The seed is ripe, i.e. preferably still on the plant, and about to be shed.
- Seeds are not subject to extremely high levels of damage, predation or abortion.

The fulfilment of all of these criteria is an ideal. In practice, small populations (less than 50 individuals) or those that will yield less than 1000 viable seeds may be collected when larger, more productive populations are not easily available. Local criteria such as imminent threat of destruction of a population or particular local interest in a population may also be important.

Sampling strategy

For many potential *users* and *uses* of the collection, it is important to maximise the number of alleles present within the sample, by capturing the greatest proportion of those alleles represented in the field population⁶. According to Brown and Marshall (1995), at least one copy of 95% of the alleles occurring in the population at frequencies of greater than 0.05 can be achieved by sampling from:

- 30 randomly chosen individuals in a fully outbreeding sexual species, or
- 59 randomly chosen individuals in a self-fertilising species.

As the reproductive biology of most target species has not been studied, and as the capture of rarer alleles would require a markedly increased sample size, **collectors are advised to sample from *in excess of 50 individuals, from within a single population, where available.***

This analysis suggests that, with care, a single population seed sample collected in this way would possess the potential for re-establishment at that site and perhaps for establishment at many other sites within the natural range of the species. The probability of successful re-establishment at the original site would be increased by reflecting the *allelic frequencies* present in the population, however this would entail sampling from a much larger number of individuals (200+) than suggested above.

In order to increase the probability of conserving material that can be successfully established elsewhere within the natural range of the species, collectors would need to make additional population samples. Some land managers may wish to pursue this approach in addition to the basic 'single population' sampling.

⁵ In this document, 'population' is used to describe any occurrence of a species, delimited by geographical boundaries.

⁶ A discussion document is available from Simon Linington if more detail is required on this subject.

In the event that additional information is available, the sampling strategy can be modified accordingly and notes made on the field data form to record the sampling used.

Seed collection

Following identification of a population suitable for sampling, before collecting the seed, the collector should:

- Carefully examine a small, representative sample of seeds using the cut test and (for smaller seeds) a hand lens. This will enable the collector to estimate the frequency of empty or damaged seeds, and confirm that seeds are mature. **Note:** Research shows that fully-formed but slightly under-ripe seed can often be successfully conserved if entire seed-heads and a short length of stem are collected and allowed to ripen in a well-ventilated environment.

If there are enough seeds ready for collecting, the following protocol should be used:

- Collect mature, dry seeds into either cloth or paper bags (the latter well secured with tape). Cloth bags should be tied correctly, i.e. around the neck, not just pulled together.
- Collect entire seed heads of awned or similar species into paper bags.
- Collect fleshy fruits directly into plastic bags, and allow them to aerate. Fleshy fruits can decompose rapidly, and poor storage can lead to mould-infested seed collections.
- In general, seed cleaning should be left to seed bank staff. However, if seeds can be liberated from their fruits quickly and easily, e.g. by shaking the open fruits over a container, please carry this out (time permitting) and make a note on the field data form.
- Sample randomly and evenly from as many plants as possible across the extent of the population, maintaining a record of the number of individuals sampled. This captures the widest possible genetic diversity from the plant population sampled.
- Where the population exhibits a pattern of local variation, it is preferable to use stratified random sampling, sampling separately from each microsite. Stratified random sampling, which keeps ecotypes separate, goes further in ensuring that alleles of particular ecological significance are collected. Brown and Marshall (1995) state that for outcrossing species, at least one copy of 95% of the alleles occurring at a frequency greater than 0.05 can be obtained by sampling from 30 individuals selected randomly. For self-fertilising species, one would need to sample from a minimum of 59 individuals to achieve the same genetic representation.
- As a rule collect no more than 20% of the available seed on the day of collection. This ensures that the population sampled is not endangered by the planned seed collecting. The only exception to this is if a population is going to be destroyed.
- Ideally collect 10,000-20,000 viable seeds. This enables maximum use of the collection, i.e. so that: (i) a part of the collection can be conserved in the country of origin; (ii) sufficient seed is available for initial germination and viability testing; (iii) viability monitoring can be undertaken at the seed bank for many decades and (iv) a substantial sample can be conserved as a long-term safeguard against loss of the wild population, and as a resource for ecological, genetic and botanical study.
- Collections of between 500 and 5000 seeds are welcomed by the MSB, although distribution opportunities will be limited. Collections of less than 500 species are welcomed from species that are either threatened or of restricted distribution. In these cases there will be limits to the quantities available for germination and viability tests.
- Where a population is very small (less than 10 individuals) the harvest from each plant should be kept separate at collection and processing, and this should be indicated on the field data form. This will ensure that the full genetic diversity of particularly vulnerable plant populations can be successfully released at a later date.
- Above all, RECORD WHAT YOU DO.

Data collection

The collection of data associated with the species or populations from which seed is taken is a vital contribution to knowledge about these plants. Habitat information such as rainfall, altitude, slope, landform, aspect, geology, vegetation physiognomy, associated species and soil characteristics have important implications for restoration ecology and amelioration applications. Population characteristics (phenology, number of plants, % of population producing seed, pollination and dispersal mechanisms, predation etc.) are useful data for conservation authorities, and information about the plants themselves (form, height, flower/fruit morphology etc.) is required by taxonomists and systematists.

The Millennium Seed Bank primary data form is reproduced in Annex 3. If collectors prefer instead to use field data forms or formats already in use by their organisation, please ensure that *as a minimum*, the essential data fields indicated by **bold** are completed.

Table 2: the MSBP data fields explained

Date collected	The date of collection is very useful in phenological studies and should always be included.
Collection number	Collection numbers should be consecutive and chronological. Ideally, the same number should be used for seed and voucher. Try to avoid gaps in the number sequence, and if you do have gaps, e.g. through spoilage of a specimen, do not re-use the number; mark it as void in your records.
Collectors	All active participants should be recorded.
Country	No explanation necessary
<i>Province/State</i>	No explanation necessary
<i>Local situation</i>	Directions to the locality, e.g. '211 km from Pretoria on N1 to Pietersburg.' This information helps relocate a population without the use of a GPS.
Latitude/Longitude	Lat/longs are determined with a portable Geographical Positioning System (GPS). RBG Kew usually uses the Garmin 12XL model, but not exclusively. Ideally, the GPS datum WGS84 should be used. If another datum is used, please state which in the box provided. GPS co-ordinates are generally accurate to 10-15 m.
Altitude	An altimeter is more accurate than a GPS. Some more expensive GPS's have a built in pressure altimeter. The Seed Bank database accepts altitude measurements in feet or metres.
<i>Habitat code</i>	A key to vegetation physiognomy relevant to this field is available from the MSBP. Collectors may prefer to use a local or regional physiognomic classification, in which case this field should be left blank.
Habitat and associated species	If an alternative physiognomic classification is being used, it should be inserted here.

	Associated species give important detail to the habitat description.
<i>Modifying factors</i>	Factors which may impact on the species collected. These may be the result of position (e.g. roadside), land use (e.g. browsing, wood cutting) or susceptibility to elements (fire, flooding etc.).
<i>Land form</i>	The level of detail required here is at the collector's discretion. At the very least, a description of local topography should be provided (e.g. flat, undulating, mountainous etc.).
<i>Slope</i>	An estimate in degrees or an indication of steepness (e.g. 30°, slight slope etc.).
<i>Aspect</i>	If a collection is made from a slope, the aspect (i.e. the direction the slope is facing) should be recorded. This information gives an indication of sun, shelter etc. experienced by the plant.
<i>Land use</i>	No explanation necessary. Examples include: pastoral, protected area etc.
<i>Geology</i>	No explanation necessary. This information can be found either in the field or from geological maps.
<i>Soil colour, texture and pH</i>	Soil colour charts (e.g. Munsell) may be used if available. If not, an ocular estimate of soil colour is a useful record. Soil texture (sand/loam/clay) is best estimated by rolling a sample of soil between finger and thumb. Soil pH can only be measured with the use of a pH meter; these are available from the MSBP if required.
<i>Drainage</i>	This information gives an idea of how much water is available to a plant population, and also provides clues as to the origin of the soil, e.g. well drained colluvial soil, poorly drained illuvium etc.
<i>Family, genus, species, infra-specific</i>	No explanation necessary. This is a field identification. Verified herbarium identifications should be detailed in the spaces provided on the back of the form.
<i>Number of voucher duplicates</i>	Two voucher specimens is a minimum; one for the MSBP and one for a herbarium in the country of origin.
<i>Area sampled</i>	No explanation necessary. Area must be given in m ² .
<i>Number of plants sampled</i>	This information, together with the number of plants found, gives an idea of what percentage of the population has been sampled. This is important information in genotypic sampling.
<i>Number of plants found</i>	i.e. an estimate of the size of the population.
<i>% population producing seed</i>	No explanation necessary.
<i>Seed harvesting (early, mid, late season)</i>	No explanation necessary.

<i>Seeds collected from (plants, ground, both)</i>	No explanation necessary.
<i>State of seeds (moist, dry, both, other)</i>	No explanation necessary.
<i>Herbarium data, including plant height</i>	See Table 1 above.
<i>Ethnobotanical data</i>	If vernacular names are provided, the language should always be noted.

Care of collections in the field

In general, **the seed collections should be kept in a cool, dry place** prior to dispatch to the seed bank but they should not be frozen. Care should be taken that seed collections do not overheat, for example by being left in a vehicle in full sun. Exposure to such sustained high temperatures can badly damage the seed collections. Attempts should be made to maintain ventilation around the collections at all times and the collecting vehicle should be parked in the shade, or at the very least, the windscreen shaded.

Damp collections should, as soon as possible, be spread out on newspaper to dry naturally, either outside in the shade or in a well ventilated room, before dispatching material to RBG Kew.

In a few cases where, for example, seeds have been collected fully mature within dry, bulky fruits or capsules, it may be relatively straight-forward and rapid to carefully open the fruits and to separate the seed by hand ready for shipping. In most cases, it is best to leave the task of cleaning the collections to RBG Kew or national seed bank processing staff who have the full range of facilities necessary to carry out this task.

Fleshy fruits may require careful handling, partial cleaning and rapid dispatch to the seed bank: contact either RBG Kew or the appropriate International Co-ordinator as soon as possible for advice.

SHIPPING SEED COLLECTIONS TO KEW

In general, **it is critical to the successful conservation of the seed that it is dispatched to the seed bank as soon as possible after collection**, together with the completed field data forms, by air freight. Voucher photos, and herbarium specimens may be forwarded to the appropriate authority at a later date, and any other additional information may be sent to RBG Kew, or to the project co-ordinator quoting the collector's name and the number given to the seed collection

Seed bags should be clearly labelled (inside and out) and then securely packaged for shipping to RBG Kew. The following packaging is recommended, either:

- Canvas or thick cotton sealable sack
- Woven PVC or nylon airfreight sack
- Sturdy cardboard box (secured with string to permit customs inspection and resealing) into which cotton (not paper) seed bags have been placed,

The following packaging is NOT recommended:

- Any non-breathable bags or containers made from plastic or PVC-backed fabric

The following procedure is recommended for packing a seed shipment:

- Pack seeds at the last minute before shipping
- Record details about each collection and the number of bags being packed into the box. Keep a copy of this information, and put the original in the box.
- Use polystyrene (styrofoam) or other suitable materials to fill any voids in the boxes
- Fill in the air waybill for each batch being shipped, and keep a copy (see Annex 4)
- Seal the boxes and attach address and customs labels
- Measure and weigh boxes
- Phone the Air Freight company

RBG Kew has an account with DHL for the sole purpose of express shipping seed collections and appropriate field data to Kew for processing. In the event that DHL do not serve your area, please contact either Kew or the project co-ordinator to agree an alternative arrangement.

Pre-printed DHL air waybills are available from the MSBP. An example of a correctly filled out DHL air waybill is given in Annex 4.

Annex 1: Species covered by UK phytosanitary regulations

SEEDS FROM NON-EU COUNTRIES WHICH ARE CLASSED AS 'QUARANTINE' MATERIAL

Origin – all third countries

Solanum – true seed of potato) **Both these species are**
Vitis) **totally prohibited**

Allium cepa
Allium porrum
Allium schoenoprasum **All of these**
Beta vulgaris
Capsicum **species require a**
Helianthus annuus **phytosanitary**
Lycopersicon lycopersicum **certificate**
Medicago sativa
Oryza
Phaseolus
Prunus
Rubus
Zea mays

Origin- Argentina, Australia, Bolivia, Chile, New Zealand and Uruguay

Cruciferae) **These species**
Gramineae) **all require a**
Trifolium) **phytosanitary certificate**

For a complete list of restricted species, which includes fruits and plant material please see 'The Plant Health Guide for Importers'. The following fruits require a phytosanitary certificate when imported into the U.K. from the countries shown:

FRUITS FROM NON-EU COUNTRIES WHICH REQUIRE A PHYTOSANITARY CERTIFICATE

Annona)
Cydonia)
Diospyros) **All**
Malus)
Mangifera)
Passiflora) **non-European**
Prunus)
Psidium)
Pyrus) **countries**
Ribes)
Syzygium)
Vaccinium)

FRUITS WHICH REQUIRE A PHYTOSANITARY CERTIFICATE FOR IMPORT INTO THE U.K.

Citrus and hybrids (must be free from leaves and peduncles)) **All**
Fortunella and hybrids (must be free from leaves and peduncles)) **third**
Poncirus and hybrids (must be free from leaves and peduncles)) **countries**

Annex 2: Checklist of tools and equipment for seed collecting

Expedition to:

Dates of visit:

RBG Kew collector(s):

Collaborating institute:

Contact name and fax no.:

Collecting permit:

Documents

Visa(s)		Copy of convenio	
Letter of invitation from collaborators		Primary data forms	
Letter of introduction from RBG Kew		List of SEPASAL species for region	
Seed collecting instructions		List of seed bank collections for region	
Key to vegetation types		Previous expedition reports	
Current seed list		Flora/identification guides	
Customs letter for import of seed into UK		Maps where available	
Customs letter for temporary export of equipment		International Driving Permit	
CITES regulations		Vaccination certificate	

Seed collecting equipment

		Quantity Suggested	Quantity supplied
Herbarium press & straps		2	
Flimsies		50	
Blotters		20	
Cloth bags	-sack	5	
	-large	20	
	-medium	20	
	-small	10	
Paper bags	-large	20	
	-medium	10	
Cardboard envelopes		15	
Polythene bags	-large	5	
	-small	5	
Numbering tags		300	
Altimeter		1	
GPS		1	
Secateurs		1 pr	
Gloves		1 pr	

Other equipment from store

Date equipment supplied:

Date returned:

Annex 3: MSB COLLECTION DATA FORM (Bold type= Obligatory Fields) Serial Number

Date Collected Collection no
 Collector(s)

SITE DATA

Country
 Province/State
 Local Situation
 Latitude **GPS used (YES/NO)** **If no, see over.**
 Longitude
Altitude **GPS Datum** or

HABITAT DATA

Habitat Code
Habitat and
Assoc. Species
 Modifying Factors
 Land Form
 Land Use **Slope**°
 Geology **Aspect**
 Soil Colour **Soil pH**
 Soil Texture **Drainage**

COLLECTION DATA - If collection has been verified, please see over.

Family
 Genus
 Species
 Infra-specific

No. of Voucher Duplicates **Area sampled (m²)**
No. of Plants Sampled % population producing seed
No. of Plants Found

Seed Harvesting (*early, mid, late season*) Please circle. Seeds Collected from (*plants, ground, both*)
 State of seeds (*moist, dry, both, other*)

HERBARIUM DATA

Plant Habit *Tree Shrub Liana Erect herb Creeping herb Climbing herb* **Plant Height (m)**
 Other descriptors

ETHNOBOTANICAL DATA

Vernacular name Language
 Use - *please circle.* Food Food Additive Animal Food Bee Plant Invertebrate food
 Materials Fuel Social Use Vertebrate Poison Non-Vertebrate Poison
 Medicine Environmental Use Gene Source

If GPS not used, please state method	<input type="text"/>
Map Publisher	<input type="text"/>
Series	<input type="text"/>
Scale	<input type="text"/>
Co-ordinates	<input type="text"/>
Date	<input type="text"/>

If collection has been verified please complete sections below:

Material verified	<input type="text"/>
Verified by	<input type="text"/>
Institute	<input type="text"/>
Date	<input type="text"/>

Annex 4: DHL air waybill

ANNEX 5: COLLECTING SEED FROM RARE AND THREATENED PLANT SPECIES

When collecting rare and threatened species, the collector needs to think about a number of factors before going into the field. To start with, it is necessary to think about what seed samples will be used for. If seed is to be used only for research, only a few seeds may be needed compared to, for example, the numbers of seed needed for reintroduction and establishment of a self-sustaining population. The collector also needs to think about potential seed losses due to mortality during experimentation, reintroduction or establishment, and compensate for anticipated losses during collecting.

Once in the field the collector needs to consider a number of other factors:

- 1) For developing germination and propagation protocols, or to examine seed behaviour, use existing ex situ material if available. If wild populations must be sampled, begin with small collections from the largest and most secure populations. For developing reintroduction protocols, make the smallest collections possible to address the management questions being posed in experimental reintroduction.
- 2) To increase the probability of successful, self-sustaining populations of threatened plant species, collect from as large and diverse an array of founders as is prudent. If possible, collect and maintain separately seeds from each maternal line.
- 3) Where possible, spread the collection out over two or more years, especially for small populations.
- 4) For species with 50 or fewer populations, collect from as many populations as possible. For species with more than 50 populations, collect from as many as possible up to 50. For populations with 50 or fewer individuals, collect from all known individuals; for populations with more than 50 individuals, collect from 50.
- 5) For populations of species with extremely low overall numbers, particularly those (a) that have 10 or fewer reproductive individuals and a poor history of recruitment, or (b) are known to be in rapid decline, collection of seed should be made at the discretion of the licensed collector. The decision about how much to collect should be based on as much information as possible, including species autecology, nature of threat, ex situ conservation facilities and knowledge base available etc.
- 6) Record as much additional information about the population as possible, including:
 - Total number of plants
 - Number of juvenile plants
 - Number of adult plants
 - Number of dead plants
 - % of plants flowering/fruitletting in the last season
 - Seed production (per fruit and per individual)
 - Threats to habitat
 - Threats to species
- 7) Avoid destructive sampling. Consider carefully whether herbarium vouchers are essential to the naming and classification of the plant sampled. Do not take herbarium samples if it will reduce the population's capacity for survival – take photos and detailed notes instead.

References

Almond, S. (2000). Itigi thicket monitoring using Landsat TM imagery. MSc Thesis. University College London.

Bridson, D. & Forman, L. (eds.) (1992). The Herbarium Handbook. Revised edition. Royal Botanic Gardens, Kew.

Brown A.H.D. and Marshall D.R. (1995). A basic sampling strategy: theory and practice. In Guarino, L; Ramanatha Rao, V; Reid, R (1995) Collecting Plant Genetic Diversity, Technical guidelines. CAB International.

Sawkins, M.C., Maxted, N., Jones, P.G., Smith, R. & Guarino, L. (1999). Predicting species distributions using environmental data: case studies using *Stylosanthes* Sw. In: *Linking Genetic Resources and Geography: Emerging Strategies for Conserving and Using Crop Biodiversity*. CSSA Special Publication no. 27.