Weed Collection and Database for Plant Protection Manual

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Plant Protection Center of DOA
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Introduction

Weed is plant that do not want it to grow in that place at that time or plant that human does not want it to grow there at that time and it is a pest. Many plants are not always undesired, some weeds are indigenous plant, medicinal plant or even ornamental plant, depending on human need. So, it become conflict and question that it is weed or not. Weeds that were listed as noxious weed in cropping area mainly are not native plants, they are alien plant which may not be recorded or report. Collecting weed samples in various places with other information are necessary and should be done.

Objective of weed sample collection

Herbaria are repositories for vascular plants, bryophytes, lichens, algae, and fungi. Specimens are used as references for comparison and identification with unknown samples, documenting species distribution and variation within species, and identifying times of fruiting and flowering, among others. So objectives for weed sample collecting are as follow:

1. For correct identification, checking it's botanical name or scientific name down to species level. Since a plant in area may have many local names while a local name may apply to several species. But one plant has only one accepted scientific name, other are synonym. Specific scientific name of the plant is very helpful for avoiding confuse. So, specimen is very important for corrected detail checking or comparing with the known one.

2. Specimen is a good reference material for recheck or confirmation of the correct identification and existing of the species. It is a good record of existing and distribution of the species in the area or in the country. In addition, the specimens can be used as reference or evidence for negotiation when international trading conflict occurred regarding contaminated of weed seed / propagule in agricultural products.

Collected plant / weed collection can be kept in good condition for long period by preservation in two forms, as followed.

- **Dried specimens**: after collecting from field, press the plant sample in press frame, drying, mounting to herbarium specimen sheet.

- **Liquid preservation**: some plants are hard to prepare as dried specimen, such as aquatic plant, succulent plants which is very thick, or parts of the plant are flimsy, such as flower, leaves including berry fruit. These kinds of samples can be preserved in liquid, including samples for display in exhibition or for studying classes.

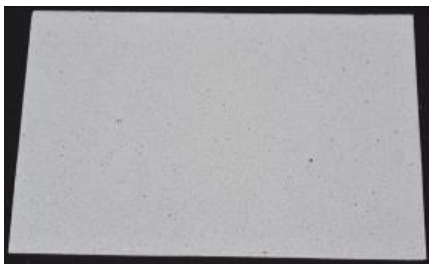
Tools and equipment

1. Plant press frames with 2 webbing straps or flattened straps: The plant press frames should be made of light weight material, such as bamboo, ply wood or metal, size 30x45 centimeter. Strap should be a flat, strong enough for tensile strength, such as wick rope of other that does not slip when binding, about 2.5 centimeter width and at least 150-200 centimeters long. (Fig. 1)

Fig. 1 plant press frame made of bamboo wood and wick ropes.

2. Material for pressing plant. Generally, newsprint sheets were used, fold the sheets in half to form 30 × 45 centimeters folders for holding the plant specimen. Sheets of corrugated cardboard (30 × 45 × 2 cm) for ventilation during drying process. Blotting paper (30 × 45 cm), and soft foam sheets **(**30 × 45 × 2 cm) are also needed to layer between plants in the press, both are optional. Blotting paper is good for speeding up drying of damp specimens and foam is useful for thick or bulky branches or stems or fruits (Fig. 2).

Folded newsprint



foam

corrugated cardboard

Fig 2 Material for plant specimen pressing: newsprint, foam and corrugated cardboard

3. **Plastic or water proof paper tag and pencil** for record sample number and tied with the sample. The tag size should be big enough for writing the number of the samples with a small hole on an end for holding a strong thread or yarn, 5-10 cm. long, The pencil should be at least 2B which is dark enough for writing on tag. The sample number must be recorded every time of collecting which may set by location or by each collector.

4. **Note book**. For recording or noting various information of the collected samples, such as number, date of collection, plant name, plant character which is important for identification and may not change after plant sample become dry such as latex, colour, smell including habitat, crop or host plant, location (-200latitude - longitude, elevation and locality.

5. **Diggers and clippers** for cutting or digging the plant samples. Both pruning shears or garden clippers and digging tools are necessary for cutting the sample from the plant and adjust the sample to fit with the press. Trowel and shovel are useful for digging plant part in soil.

6. **Plastic bag** for keep the cut sample and prevent wilting before pressing. The bag should big enough and tightly seal to prevent moisture lost, small amount of water should be added before close or sealing the bag.

7. **Camera** for recording plant character which useful for identification and habitat. Some plant characters such as flower, leaves, fruit or other specific character the species may change or not clear after drying. Some plants have very tiny flower or other parts, close-up lens is needed. Nowadays, many models of digital camera attached with GPS (Global Positioning System) receiver which can record the location, latitude, longitude and elevation, with the images, it is useful for checking the location later too.

8. **Altimeter** for checking the height above sea level of the location where the samples were collected. Nowadays many mobile phone or smart phone has GPS receiver and many applications which can use for checking the location and the height about sea level of the location too. It can be used instead of altimeter too.

9. **Liquide preservation**, since some plant or some part of the plant are too thick or to thin which cannot prepare as dry specimen, such as berry fruit, thin petal, some aquatic plants. Glass or plastic bottles in various sizes with lids are needed including 70% of ethyl alcohol.

10. **Other tools** which is useful for collection and checking plant character, such as binocular, hand lens (for field observations and identifications a small 5x or l0x lens is desirable).

Weed sample collecting method

Weed sample collecting is not different from plant collection of plant taxonomist, but weed collection is done in agricultural area mainly.

1. **Selection weed sample**: choosing plant with important parts for identification, they are: stem, flower, leaves. The chose samples should be complete, without damage from insect or disease inflection. Some weeds have very vivid character different from other plants which can be identified even without flower, such as *Coldenia procumbens* L. (Fig. 3), however it should be chosen only the one with complete leaves, flower and fruit. The complete sample should include root, but if the plant is bigger than plant press, such as *Mimosa pigra* L., perennial plant, it is impossible to have root in the sample, choose branches with inflorescent and pods (fruits), about 30 centimeter length which is not longer than the plant press (30 x45 centimeter) and mounting paper (30 x 42 centimeter). If the chosen sample with inflorescent and leaves longer than plant press or mounting paper, the sample should be bended or curved to fit the plant press and mounting paper.

Fig.3 Plant habit, leaves and flower of *Coldenia procumbens* L.

2. **Weeds in croping area** may be bigger than the one found in non-agriculture area where no human activities. Since they get fertilizer and water applied to crops. Leaves of weeds in fertile soil may be much bigger than one in unfertile soil. Moreover, annual weed of the same area but in different season also different in size, such as ones in wet season are much bigger than ones in dry season. The ones in dry season may be

very tiny since of drought. So, collecting weeds in agriculture area should collect various sizes but complete.

3. **Weed with several forms of leaves.** Some weeds many have many forms of leaves or leaves form change by age or stage of the plant. Collecting the weeds sample of these weeds should cover all form of the leaves. Such as *Emilia sonchifolia* (L.) DC. ex DC., it's leaves near the ground or lower part of the plant have long petiole, the width and the length are not much different, while the upper leaves with clear lobed margin and the length is longer than the width. (Fig. 4)

Fig 4 *Emilia sonchifolia* (L.) DC. ex DC.

4. **Weed with underground stem or propagule** or root with extra character such as tuberous root, so the underground part of these plants should be included with the samples. Digging the underground part and removing soil must be very carefully not to broke the underground part out from the weed. For sedge (*Cyperus* L.) underground stem or rhizome is an indicator of perennial plant, such as Nutsedge, *Cyperus rotundus* L. (Fig. 5). Sorrel or broadleaf wood sorrel or fishtail oxalis (*Oxalis latifolia* Kunth) produces bulb at l consist of many scales above taproot and bulbil at the end of stolon which ready to germinate as new plants (Fig. 6). So, collecting samples of these plants should be include the underground parts.

Fig.5 Purlple nutsedge (*Cyperus rotundus* L.) above ground and underground parts (rhizome and stolons).

Fig. 6 Above ground and underground part of fishtail oxalis (*Oxalis latifolia* Kunth.)

5. **Amount of sample to be collected.** The number of samples collected should be high enough for examination and identification, generally it should be 2-6 pieces for one species. But if the collector needs to exchange and distribute with other herbarium, the number of samples should be increased. Since weeds are undesirable plants in cropping area where concern to human activities including introduction of exotic plants which likelihood of contamination of seeds or propagules of other plants. The contaminated seeds or propagules may germinate, grow, increasing number, spread out and become weed in new area. They may alien or exotic plant where no record in the country before and may not able to identify in the field, so it should be collected many pieces for identification and sending to plant taxonomist in other organization for identification.

6. Data recording. Generally, some weed character which may change after become dry, those characters must be recorded for identification, such as colour of flower, leaves. Weed / plant sample without recording data is useless if no data

attached. So, collecting weed samples for beneficial on plant protection and bio-diversity, some data should be recorded with the samples. They are:

- **Collecting number**: the collecting number on the plant samples (with string tags) must be the same figure with the one on note-book. In a location, many pieces of plant may collect for each species, they must be the same number and amount of each species collecting must be recorded too. This collecting number will be the same figure with collector number for individual collector. Some collector or team of collectors may desire to use code of location or project as collecting number, so the number will start from 001 for next location or other project.t

- **Collecting date.** Date, month and year of collecting must be recorded. From these data it useful for biology such as season of growing, flowering period, infestation

- **Host / habitat**. Recording of host plant or crop where the weed samples were collected including habitat are needed which are useful for information of crop species where weed found and where or what kind of habitat that the weed can grow. Some detail of crop should be recorded such as stage of growth of the crop; seedling, mature plant, flowering stage, harvesting; cultivation: how the crop was grown, upland, paddy, or bed, including other data concerned. Example of data recorded in banana filed: **Banana**: young plant about 1 month after transplant.

Cultivation in row on bed with about 2x2 m.

Land preparation from paddy field.

- **Locality**. Address of collecting place must be recorded which is useful for monitoring of the weed in future, such as county, district, province. Nowadays many models of digital camera and smart phone have Global Positioning System (GPS) receiver unit, the GPS data can be record onto the image took. If internet network is available, the address of the location may able to retrieve but not always, since some area may restrict for public information.

- **Altitude.** The average height above sea level of collecting site is important. It may able to get from altimeter. Nowadays many smart phones have GPS unit which can track the location including altitude, depending on the application and setting. As well digital camera with GPS unit which need to set up the for unit of height and recording.

- **Note.** Other information of the weed that may changed or unable to show in the specimen or difficult to observe from dry samples, such as plant height (in case that whole plant cannot collect) such as height, colour flower, odor, latex, or other character

that useful for identification. Including other information from collecting siite such as local name which got from farmer or people in the sites.

Collector Number. Name of the collector may in short or code, depending on the collector, but it should be easy to understand, recognize, convenient for making note and must be different from other member in the team or group, then follow by number. Each collector uses his / her own code with continuously increase the number as the sample is increasing. In case of collector in team, the code for the team should be determine which must different from individual collector and distinguishable. And members of the team must be recorded in note. The collector number of the team start from one and increases continuously as the collected sample increasing. And if the team continue on collecting in other site, the code and the number can be continued.

Tag with string should be tied to stem or branch where strong enough, tightly tied to avoid loosen from the sample. The string should long enough for tying long. If the string is too long it will disturb arrangement the dry specimens many pieces at the same time.

Collecting the samples from field and put in big plastic bag before pressing, must be aware on some delicate weeds which are easy to wilt cause difficulty and take time on arrangement when pressing. Many narrow-leaves weed or Poaceae weeds samples always longitudinal curve in hot and dry condition, so if possible some water should add to plastic bag and tightly close the bag by rubber band with air inside like balloon which can delay wilting, curving of the sample and protect weed samples to be damaged by crashing with other until pressing. However, some plants with flimsy leaves, they should be pressed as soon as possible or suddenly after cut from the plant or dig out, but carrying pressing frame to the site may not convenient. Temporary pressing frame (Fig. 7) which made of blotting paper with hard cover may be used in the field, tighten the temporary pressing frame with straps, and transfer to pressing frame in the evening or at convenient places, and continue on pressing in the manner of the fresh sample.

Inner of blotting book blotting book with folders of newsprint

Fig 7 A hard cover of blotting book that use as temporary pressing frame.

Pressing plant samples

To get beautiful or good dried plant sample, pressing should be done suddenly after it was removed from the plant or from the soil. Laying the sample on a folder of newsprint, cutting branches to make the sample fit for the newsprint and the frame, no any parts of strait out the frame. Arrange the plants carefully with a minimum of overlap. Open some flowers to show both the top and underside to illustrate the arrangement of floral parts and the presence or absence of involucre bracts. Open the flower and press it down. Squash large fruits on the page or slice them in half to speed up the drying process. Place dry, loose seeds or fruits in sealed packets. Turn over some leaves or part of a single large leaf to show the underside. When the sheet is full, close the folder, place blotting sheet or sponge sheet between newsprint folders to keep the plant samples especially thinner part well pressed. A corrugated sheet should be place after 2-3 layers of plant samples in newsprint folders to let air flow and speed up drying. After all plant samples were arranged in newsprint folders, then put cardboard separator or corrugated sheet on the top, then all were transferred to the press. When the press is full, tighten the straps or wick ropes as strong as possible (Fig. 8). Check the straps after drying for 4-6 hours, if it becomes loose re-fasten. Keep tightening the straps until the drying is finished. Check and change damp newsprint daily and remove specimens as they become dry.

Fig 8 The plant press full of weed samples in newsprint folders, blotting sheets (sponge sheets) and corrugated cardboards which ready for drying.

Some plants may have part or parts which difficulty to press or some may be delicate, very thin and stick on newsprint sheet when dry, these kinds of sample should be pressed by some technique as followed.

- Plants with delicate, very thin petals, such as morning glory, orchid; placing wax paper sheet or cellophane sheet on and under the flowers to prevent the flower stick on newsprint sheet and tear when removed.

- Plants with very thick petal, such as hibiscus which easy to inflect by fungus and stick with newsprint sheet, placing thin blotting sheet above and under the flower. Before pressing, may dip the flower in 70-95% alcohol or formalin to kill cells which speed up drying.

- Plant with flower on big stem or branch, leaves and flower may fall down or tear off when pressing because of pressure from plant press. It is recommended to cut newsprint sheets into small size and place under the flower to level up the flower to the same height with stem or branch. Place the corrugate sheet between the samples one by one.

- Thorny plants, the thorns that pint into the corrugate sheet should be cut except thorns on leaves margin or fruit. The cut out parts should be kept in small bag for identification or drying and put in envelop then mount to mounting sheet with the plant specimen which useful for checking plant character without destroying the mounted specimens.

Drying plant samples

The plant samples in the plant pressing frame should be dried up as soon as possible because it may be damaged by fungus. Drying the plant samples can be dried up by these methods:

1. **Sun light**: Let the plant press frames with weed samples out side to expose sunlight without shading and dews or raining. The newsprint folder should be daily changed to reduce risk of fungus and speed up drying of the samples.

2. **Heated**: Simple heating equipment can be used such as heating by using lamps (such as 100Watts light bulbs) as source of heating underneath the drying rack 0 (Fig.9). Then place the plant press with weed samples above the lamps. The drying rack should be set in open air with good air ventilation.

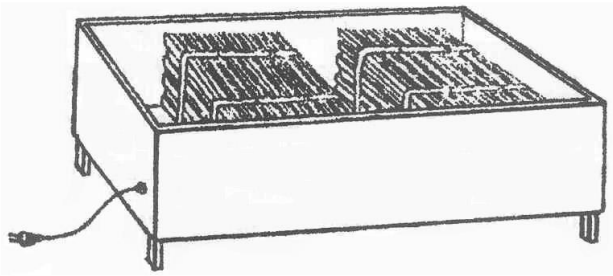


Fig. 9 Plant specimens drying rack with light bulbs as heating source.
(Botany department, Faculty of Science, Chulalongkorn University, 1987)

Nowadays, big side forced-air ovens are available, some model are big enough to place plant press with weed samples inside. The advance of modern hot air oven is able to set for desirable temperature and duration of heating. Generally the temperature used should not greater than 50 degree Celsius, the temperature should keep constant for 3-5 days depending on thickness of the samples. If the temperature is too high, the internal structure of leaves and flowers will be damaged. High temperature for long period can result in blackened, discolored, and brittle specimens which may cause broken of the specimens in next processes.

However, any of drying method, the plant press with plant specimens should place in the manner that the hot air can flow pass through. Good air circulation will speed up the process. The newsprint or paper folder should be changed especially initial period of the drying process when the plant sample with high moisture, the changed newsprint can be reuse after it was dried. The straps of the plant press should always keep tight, after the plant sample become dry it will be shrunk, made the straps become loose. Loosen straps can cause the leaves and flowers wrinkle.

Pest preventing

The complete dried specimens may damage by insect or fungus after keep for long time. Chemical for prevent fungus and insect may apply to those specimens before mounting. The chemical can be prepared as following:

1. Mercuric chloride: 50 milliliters.
2. Phenol: 10 milliliters.
3. Alcohol (90%) 2 liters.

Mix and stir the mixture in glassware of enamel container, then pore to a wide-mouth container such as plastic tub or enamel tray which is big enough to place the specimens without bending or broking the specimens. Dip the specimens in the mixture by use wooden tweezers press the specimens to thoroughly wet for 30 seconds, then take out and place in the newsprints folders. Arrange the newsprint folder with specimen and corrugate sheets on plant press frame in the same manner of pressing, tightly the straps and drying until complete dry.

Caution: Mercuric chloride is toxic and considered as a carcinogen. Must be careful not to inhale and avoid any part of the body to expose to the mixture. Wearing protective mask, wearing gloves and work in good ventilation or in big flume hood. Avoid metal tools since the chemical is corrosive. The newsprint folders exposed to the chemical should not reuse.

Since the mercuric chloride is toxic / carcinogen and parts of the specimen may crash and broken when dipping, recently many herbaria stop using the mixture. Using freeze treatment instead of chemical by placing the complete dry specimens in big plastic bags, completely seal the bags and place in deep-freezer at -30°C for 72 hours then bring out and left at room temperature until it become warm and dry then open the plastic bags and bring out the specimens and return to the shelfs. But if the specimens was not dry enough, they may be dried in oven at low temperature before return to the shelfs.

Mounting specimens

The mounting paper for plant specimens commonly is an acid free about 300 gram white paper 30x42 centimeter. Only the complete and dry specimen should be mounted. The steps for mounting are:

1. Spread glue on a plain mirror which should not smaller than the mounting paper or about 30x45 centimeter, using painter brush to spread the glue thoroughly the mirror.

2. Take the specimen by tweezer, place the side that should attach to the paper down to the glue, press the specimen to touch the glue thoroughly.

3. Bring the glued specimen and place on the mounting paper around the middle, left enough space for labelling sheet (10.5x13.5 centimeter) at the lower right or left. Thoroughly press the specimen to firmly attach the paper.

4. Placing newsprint sheet on the top then place a small sap of soil over the newsprint sheet to press the specimen firmly stick the mounting paper.

5. After the glue dry, using white thread to fix the specimen to the mounting paper, the thread should be strong enough but not too big. Fixing from the lowest part of the stem or branch to the top, or using twist tie or glue ribbon instead of thread, because glue may expire in long period without thread the specimen may loose from the mounting paper.

6. Labelling. Stick the label sheet with information about the specimen typed on 10.5x13.5 centimeters sheet on space or room at the bottom right or left depending on the space. The information on the label sheet consists of:

- Plant name, Family, Botanical name and local or vernacular name.
- Locality including latitude, longitude and altitude.
- Habitat, crop, and others information.
- Collector and collector number.
- Collected date.
- Number of duplications.
- Examiner (identified by/ determine by….)

Each herbarium may have different information and form of labelling, depending on objective of the collection. In case of sample for plant protection research purpose, it needs to record the host plant or crops. Samples of labelling on plant specimens or voucher specimens are shown in Fig.10.

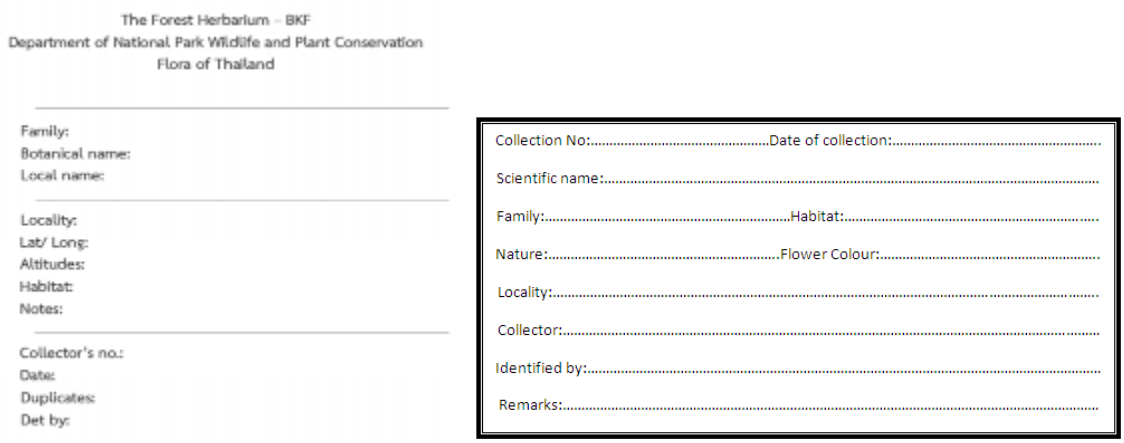


Fig 10 Sample of labels on voucher specimen

The plant specimens or voucher specimens which good preparation and keep in suitable condition, it can be kept for long period which still complete without damage from insect or fungus, as shown in Fig.11, a sedge sample of Bangkok Herbarium (BK) which was collected on March 3rd, 1918 or more than 100 years ago, but still complete.

Fig 11 A voucher specimen of BK which collected on March 3rd, 1918.

Liquid preservation

Some plant samples are not fit for making dry specimens such as succulent plant, berry fruits. They are difficult to press and pressing may change the figure. The liquid preservation may use by start as soon as possible and all character which may change such as colour, sap which cannot see in the preserved samples. For weed samples mixture that use for preserve is the same one of general plant sample. Mixture of alcohol and glycerin is widely used and may be prepared in the following manner:

95% Ethyl alcohol	700 cc.
Distilled water	300 cc.
Glycerin	5 cc.

Mixed 95% ethyl alcohol 700 cc and distilled water 300 cc, after mix well then pore 50 cc of glycerin into the mixture, stir until well mix. This mixture can use as liquid preservative solution for most plants

The preserved plant sample, usually in transparent container like glass bottle which can clearly see plant characters. The container must have label too. But if the sample in bottle is a part of the plant sample, such as berry fruit, the collecting number should be the same number with the plant but follow by letter. And it is necessary to check, add and change the preservative solution periodically.

Accessioning (filing the mounted collections in the herbarium)

The mounted specimens which dry and ready to transfer to herbarium, first of all it need to register to herbarium and get herbarium number/ accession number which is unique, unless duplicate sheets of the same species, collected at the same time and place or parts of a plant that will not fit on a single herbarium sheet, they can be designated by letter (a, b, c). Then the custom-made herbarium stamp and a sequential numbering stamp. For example: herbarium of Weed Science section of Plant Protection Center may design WS-PPC as her name in short and made it as custom-made stamp, the accession number starts from 0001, so the voucher specimen will be WS-PPC 0001. Accession numbers are assigned chronologically as specimens register.

Arrangement the voucher specimen to the shelfs or cabinets, checking the scientific name, genus and family then follow its group. For weed herbarium, it may group weeds, grassy weed or narrow-leaf weed, broadleaf weed, sedge, fern and other, then members of each group run by alphabetic order of family name, then genus under family and species under genus also arrange by alphabetic order. Each herbarium sheet has a

white cover with label of it's scientific name and family. Herbarium sheets of members in a genus are alphabetic arrange in a brown cover or folder. Each genus folder should has a hard paper board as separator and supporter when move the specimens out for checking. The cabinets for herbarium sheet should be 250 cm. high, 150 cm. wide and 75 cm depth, with cells inside (Fig. 12). Nowadays if budgets are available, each herbarium may equip with movable compactor store shelves (Fig. 13) which is more capacity with the same space of store cabinets

The room for making herbarium or keeping the herbarium sheets should have good air circulation or good ventilation and not high moist for avoiding fungus.

(http://www.campaignactivity.com/museumthailand/upload/cover/1497864175_6772.jpg)

(http://www.campaignactivity.com/museumthailand/th/museum/Princess-Sirindhorn-Plant-Herbarium-Museum)

Fig 12 Herbarium sheet storing cabinet and shelfs inside.

(http://www.deqp.go.th/virtualmuseum/html/gallerry_sirikit/6/index.html)

(http://www.qsbg.org/webbgo/science_1.html)

Fig.13 Movable compactor store shelves with cells inside.

Weed Database

Plant database means collecting of various data and information about weeds in the same fields as systemically by using computer as a tool for data collecting. Those data fields can be processed for adding, editing or delete or erase and checking.

So, weed database is collection various data and information about weeds in the same manner with plant database, but the detail of each weed is not only taxonomy but also plant protection and other field concern if available, depending on the objective of the database. For example, for one who is not in the field of weed science using only common name or local common name of weed may not communicate, adding images of the weed will be helpful. Since very few weed scientists are good programmer, so it is convenient to set a simple database for preliminary use among staff by using the general available software, such as Microsoft Excel. This is a step of data preparation for more complicate database that need specialist to manage and allow public to access in different level which needs high capacity personal computer as server and special program or software manage by specialist on information technology with collaborate with weed scientist as data or information provider and user to supply the demand of the organization in form of user-friendly and attractive pages

So, basically weed database for plant protection which prepare in form of table by Microsoft Excel, at least should consist of fields listed below.

1. Local name or vernacular name, name use in local or regions of the country. One weed may have many names, and a name may call for many weeds.
2. Scientific name or Latin name or botanical name. A plant species has only one accepted name and a name is used for one plant species only.
3. Synonym or other scientific names which can be checked from online plant taxonomic database or plant database such as Plants of the World Online, the Plant List, GrassBase or the Online World Grass Flora.
4. Common name used in other countries, mainly English names.
5. Native or native range: the origin or center of diversity of the plant.
6. Plant characteristic which consists of detail on:
    - Habit: the plant is herb, shrub or tree; annual or biennial or perennial; monocotyledon or dicotyledon but in case of weed it may record as narrow-leaf weed, broadleaf weed, sedge, fern or other.
    - Stem: erect, prostrate, climber, branches, etc.

- Leaf: shape and form, arrangement, such as simple leaf, compound leaves, arrangement in alternate or opposite.
- Flower: simple or inflorescence; position of flowering such as shoot tip, axillary bud, stem; colour of petal, flowering season, etc.
- Fruit: simple or aggregate or multiple fruits. For simple fruits, fleshy or dry fruits. Fleshy fruits may be berry or drupe or pome or hip. Dry fruits are dehiscent fruits (follicle, legume, capsule or silique)or indehiscent fruits (achene, caryopsis or grain, samara, nut)
- Seeds: size, shape, color and surface.
- Reproduction or propagation: by seed, tiller, rhizome or tuber.

7. Habitat that often found the weed.
8. Host plant or crops that found the weed growing.
9. Crop lost due to the weed or impact of the weed on crop, human, animal or other plants.
10. Control especially control of the weed in various crops.
11. Management; controlling of the weed in long term.
12. Noxious weed or invasive plant; any reports mentioned about the weed as noxious weed or invasive plant any where or it may have other special properties such as allelopathy, other noxious weed which may be checked from reports.
13. Utilization; such as medicinal plant, dye, which can be found from various documents.
14. Images of the weed: it should be insert as link because if the images were kept in the same file, it will cause the file too big.
15. Reference: sources of information that used or mentioned in all fields should be mention as references.
16. Other: such as history of introduction of the weed in other countries, it's natural enemy, quarantine pest, including problem on international trading that caused by the weed.

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