Weed Surveillance Manual

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Chapter 1
Importance of surveillance

Weed is an importance pest which costly for control in any crop production. In agricultural area, first thing that need to consider when planning for new crop production is weed. Soil preparation can be a method to control germinated weeds by plowing resulting in turning the weed into the soil, but the weed seeds in soil will be turned to soil surface, if they are still viable, they may germinate when soil moisture is suitable. They can grow and compete with crop. Generally, weed causes serious impact on crop at the early stage of crop which calls critical period of competition. The critical period of competition of each plant depends on the life span of the crop, it may take around 1/3 of life span of the crop, except for tree crop and short life vegetables. Short life vegetables and small crops, weed plays importance role until harvesting period. At harvesting period of many crops especially perennial crops, weed may be completely ignored since the impact was declined and weed does not directly damage the yield as insect and plant pathogen. In Thailand, herbicides were imported more than 50% of total agrochemical for agricultural pest control, both cost and quantity, and it trends to increase year by year. It means that Thailand pays more than 10,000 million Bath for importing herbicides.

Many weeds which are troublesome in agriculture of each country mainly are not native to that country. Since in cropping area concern to human activities all the time. Introduction plants from various sources to grow are risk of introduction of seed or vegetative propagule of other plants which may germinate, grow, spread out as weed. Including the introduced plant may become weed too. Weed in cropping area may change quickly both diversity and quantity. Moreover, weed size also vary due to fertilizer from agricultural practice of the farmer. These alien plants which become weeds in cropping area may be widely distribute or not depending on the invasiveness and how long they were introduced. Introduction of these weeds may not be recorded or reporting on present or infestation before. So, survey and collecting weed samples in those cropping areas are not only the samples for identification and confirmation, but also getting correct and up-to-date data on weed diversity and infestation. The data got can be used for planning on weeds management in those area, depending on objective and planning of the survey.

Presently, international trade on agricultural products, member countries of WTO (World Trade Organization) can use Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) on important principle which is necessary for control imported Food and agricultural product to prevent risk or dangerous for human, animal or plant in the importing country. The international standard on plant that use as reference is International Plant Protection Convention, IPPC, which is on the important basis of harmony, equality and transparency, by each country must set up National Plant Protection Organization, NPPO, for implementation of the IPPC requirement. With the advance of communication and transportation technology nowadays, trading system and logistic system are more effective, cause trading between countries or regions increases very fast, resulting in increasing of movement of agricultural product both diverse and quantity. Those agricultural products may from the same source or different, or new product which never been imported before. Each country can use the SPS agreement to control importation or trading barrier of agricultural product. Pest risk analysis was performed to find species of pest that may attach with the product and risk management measure to reduce risk. The export country needs to submit pest list of the product to the import country. Beside these, to promote agricultural product as new goods for exporting, the exporting country must apply for market access which list of pest, including weed, must be attached.

So, survey and collecting weed samples may have many objectives and utilization, such as:

- to correct and up-date weed database and samples for confirmation or recheck later.

- to prepare pest list in various crops.

- to examine, monitor, and surveillance of a weed or alien plant which likely to be noxious weed.

- to confirm present / absent of some weeds in the defined area.

- to be basic data for planning on target weed management or in a defined area.

- to examine infestation of alien pest or pest that was introduced from other sources

Understanding the objectives of the survey yields to choose correct survey and sample collecting methods to serve the objective of the survey.

Chapter 2

Survey and weed sample collection

Generally, pest survey is survey to know the status or situation of concerned pest and for management planning. Recently the advance technology of communication and transportation make people to travel across geographical barrier with in short period of time, resulting in high increasing of international travelling and international trading, especially agricultural products. If any pest contaminated or attached with agricultural product, it may grow, reproduce and become pest in new habitat. So, various measures must be applied to prevent pest contamination or attachment. Agricultural pest management is important not only on quantity and quality of agricultural product, but also on international trade. In the initial stage of implementation of SPS measure instead of Tariff measures. Management of pest that attached or contaminated with agricultural product may treat at the entry point or on the way before entering. However, to increase effectiveness of the risk management measure, the treatment was assigned to do at the original of the product by the treatment for pest management must be done at the production site. Before allow to import agriculture product by the exporting country must send pest list together with request for market access. So, pest survey is not only for up-to-date data but also important for international trade.

Pest survey for evidence as reference officially needs planning, recording and correctly practice. So, design of survey and sampling methods should be known before practice.

1. **Method** of weeds survey; which method should be used depending on the objective of the survey. Weed survey methods that should know are listed below.

Surveillance means an official process which collects and records data on pest occurrence or absence by survey, monitoring or other procedures

Survey means an official procedure conducted over a defined period to determine the characteristics of a pest population or to determine which species occur in an area.

1.1 **General surveillance:** A process whereby information on particular pests which are of concern for an area is gathered from many sources, wherever it is available and provided for use by the National Plant Protection Organization or NPPO.

1.2 **Specific survey:** procedures by which NPPOs obtain information on pests of concern on specific sites in an area over a defined period of time. There are many survey types of specific survey, such as:

1) Detection survey: survey conducted in an area to determine if pests are present.

2) Monitoring survey: ongoing survey to verify the characteristics of a pest population.

3) Delimiting survey: survey conducted to establish the boundaries of an area considered to be infested by or free from a pest.

2. **Survey site choosing**: after determine the survey, such as weed survey in a crop, so it should be performed in the area that the crop was grown. Data get may be level of region, province, district, depending on the detail information about the growing area available. Number of survey sites may be high, size of the survey site may different. It is impossible to survey every plant of the crop, how to select survey site, sampling site to get acceptable and reliable data. There are many methods to choose survey sites depending on the detail needed. If very detail data is needed, it is time consume and need big amount of budget. Moreover, it needs to consider about limitation of travelling and physical condition of the production sites. So, the level of the detail should be discussed and determined before performing the survey.

If there are many sites, it is 2 options to choose survey sites.

2.1 Survey all sites (or full sampling of that level). Full sampling provides the most detailed data of all the survey types.

2.2 survey some sites. If it is hard to attend all sites at each level, it needs to select which ones to attend. To do this it can be used one or a combination of four tools.

1) **Random sampling.** It needs to assign all sites (of the same level) a number or symbol and then by using a random number generation method, the sites are selected

and recorded. For example: there are 92 farms of a corn production area and needs 20 farms. Random number table of 00001-99999 may be used.

56888	17938	03701	19011	21795	81858	84375	52174	30547	01838
49616	05027	58559	77518	88818	15510	05166	17778	45383	63979
87810	50654	12571	64281	18565	63604	97574	77022	10497	70113
77768	24763	85849	17644	59367	55704	67362	91953	87927	54886
15685	77153	56972	83849	91933	04399	54762	71614	87482	66997
57092	05782	67929	96388	87619	87284	16247	86247	68921	61431
45805	97856	91292	58860	19103	04612	88838	39043	28360	38408
52092	41346	76829	28270	42199	01882	43502	20505	92532	87558
78094	24397	88649	24778	14083	25737	96866	53011	60742	04056
42069	88809	18431	08841	19234	28425	08699	86805	11950	71287
88748	65229	69696	94302	99033	64739	41696	46127	05953	25836
77027	57205	73195	17923	13149	23871	64516	54129	60723	12240
14727	32085	97754	87565	68544	47424	18127	39214	31843	50282
67741	79843	97622	21539	83690	87439	42371	92319	95824	77041
73620	81275	57875	76408	47690	23760	67511	71723	86944	46318
27839	40135	78953	09577	70296	79014	72997	52780	62760	34873
81980	85841	90030	81070	98649	97659	10671	89893	21450	57957
63538	95903	70908	23910	57908	67982	27523	62498	27636	02209
34182	62714	03756	64533	26160	20042	11142	00536	93365	08796
30918	27213	10699	59679	59136	82891	77801	62105	81536	91477
85473	23571	50458	11012	03006	83667	68269	23315	18286	48988
53811	39465	95669	80783	34150	65472	90418	48305	32304	23130
90354	51729	98512	79972	29695	38245	38004	81201	31328	38571
75420	48164	33446	07120	13909	10215	51857	19984	41887	17670
00454	95064	31329	06519	85296	07531	22075	30769	73421	17858
61307	17016	64835	16959	47499	42525	38932	33886	48382	88842

A part of 00,001-99,999 random number table.

This random number table provided sets of 5 digit-numbers, the number may use in row or column. Using this table to choose 20 farms for attending. The number of farms is 92, 2-digit number, so the number in a set may use in 1-2 pairs, such as a pair the first and second digit, third and fourth digit, or skip the third and make pair of fourth and fifth digit, it needs to be the same method through the survey. Continue on case of 92 farms, pairs of first and second, and third and fourth digit and skip the fifth digit, as omit the pair of digit that less than 1 and bigger than 92 which pairs of 1-9 will be 01, 02…….. and 09. The first row of the table is 56888, 17938, 03701, 19011, 21795, 81858, 84375 52174 30547 01838. The numbers got are 56, 88 and skip 8, next are 17, skip 93

(over 92) 03, 70, 19, (skip 01 and 1) 21, 79, 81, 85, 84, 37. Then continue in the same manner with the next row until complete 20 random numbers.

In case of 3 digits, such as total farm is 480 then the number to be selected shall be 001-480. The random number must be 3 digits, when reading from the random number table, the 3 digits from left or right or the middle 3 can be used, depending on the user but it needs to be the same manner through out the random. From the random number table above, the first row is 56888, 17938, 03701, 19011, 21795, 81858, 84375 52174 30547 01838. If the middle 3 digits use, then the result from first row is 688, 793, 370, 901, 179, 185, 437, 217, 054, 183. The number which is higher than 480 will be skipped or omitted. Continue on random with the next row until complete.

Another method for random is using Microsoft Excel program with the command =RANDOMBETWEEN(minimum value, maximum value), after input a command one figure will show up, then copy and paste for next value, repeating copy and paste until getting the designed. For example, from above sample, random for 20 plots out of 92, the result is shown below.

Random number		Rearrange in column		Rearrange all	
80	65	31	4	4	55
92	41	40	16	16	61
91	43	55	18	18	65
66	27	61	25	25	66
31	69	66	27	27	68
55	25	68	34	31	69
40	16	77	41	34	77
77	34	80	43	40	80
61	4	91	65	41	91
68	18	92	69	43	92

The result of random, the figures got are not arrange in order, to make it easy for planning or working in field, the random figure should rearrange as ascending or descending.

If the internet access is possible, program for random may be search by key words such as random number or random number generator. Many webpages can be found and may provide program or table for random.

2) Systemic sampling: involves selecting criteria to divide the sites into some form of regular intervals and then selecting on that basis For example, surveying every second site when listed by name in alphabetical order, or survey every three farm or every farm that ended with 4. Or setting a distance interval, such as survey every 5 kilometers.

3) **Stratification**: it uses in combination with random sampling, involves dividing the sites into logical categories and then systematically or randomly choosing sites from within the categories

4) **Targeted site selection**: choosing bases on where the pest is most likely to be. This selection method is convenient for early detection of alien pest which attach may attach or contaminate with imported agricultural commodity, before the alien pest spreading. Port of entry or first stop site after entry, as well travelers may introduce pest at port of entry, such as international sea-port, international airport. Some pest may distribute or spread out naturally by wind or river. Naturally spread may affect to likelihood of across boarder and islands. The pathway and the route of commodity become an important target site of the survey in beginning stage because it is high risk area. This high-risk area should be intensive surveyed and slowly decrease the frequency of sampling as the distance from the entry point increase. It means that determination and choosing the survey sites bases on data analysis of the exotic pests, such as pathway of introduction, spreading of the pests and habitat that often found the pest.

The advantage of this target site selection is useful for searching or detecting of alien or exotic pest at early stage before it spreading out. The disadvantage of this method is about the number or amount of pest found in the site, it may unable to be represent for other sites.

3. **Sampling or point survey choosing**: Pest survey needs record of pest found as well samples for identification, confirmation and evidence, how to choose a sampling point or point to record and collect sample. After knowing the farm to survey, then we need to design for sampling points or points for survey in the farm. There are many

methods for choosing point for collecting samples. Most of them are similar to those of site choosing. But sampling point is in much smaller scale.

3.1 Full sampling: examining all the sites at a particular level. This could be full sampling of all places right through to surveying all sampling sites at a field site or no selection of the sites which will detect any pest present and avoid bias of selection. Data get from this method is high confidence and can be used for to estimate prevalence and as part of early detection of pests or in monitoring surveys while the pest is in low density. The disadvantage of this method is time and budget consume in each field and get a lot of sample of the same pest.

3.2 **Random sampling:** all sites and host plants cannot be examined; each survey site or farm may be very wide where may not possible to visit every plant and will consume a lot of time. So, random methods can be used to determine the points in the field or farm to visit to record and collect pest samples.

1) **Zigzag, W shape and diagonal:** walking in large zigzag pattern or W pattern or inverted W pattern and/or diagonal pattern across the sampling field, record every weed species found. This method can be use in crop field or forest, but if need to survey many times in the same field, such as monitoring survey of some specific pest, may repeat the same point or the same tree which resulting in unequal chance in being examined. So, the starting point in the field should be rotate or change direction of walking to provide equal chance of being examined.

2) **Using random number table**: it is the same as random for site choosing, but the random for sampling point need to divide the field into grids and put the number for each grid. Then random by the same manner with site choosing until reach the number designed.

3) Systemic sampling: mapping out a site and surveying at regular intervals of distance, area or host plant. It can be performed in many means, such as

- divided the field by lines which pararelle to the width or vertical line to the road at least 3 lines with the same interval, then walk along the lines.

- in field which crop was grown in rows, determine the first row to examine, skip for x rows then examine through the line, repeat with the same manner until reach the number designed, such as examine every 5 rows.

4. Data recording; data recording for weed survey is similar to that of other pest, data to be recorded are:

4.1 **About the sampling field**

   1) Crop: what kind of crop, age/growth stage, how it was grown; some upland crop was grown in row, some were grown on a raise bed, some crop trees were grown in row between groove. Paddy rice may grow by transplanting in rows, dry sowing, germinated seed sowing, parachute. Since growing pattern effect on weeds too.

   2) **Location and habitat**: location such as province, district, subdistrict, village including latitude and longitude from GPS. Habitat of the survey site or sampling site should be noted. Land use history is an factor that effects on weed species, weed is not specific to crops, but depends on habitat. Such as most weed in paddy field, mainly are weeds of high moist soil or wet soil, such as, chickenspike (*Sphenoclea zeylanica* Gaertner.); yellow velvetleaf (*Limnocharis flava* (L.) Buchenau). But these two weeds were found as weed in soybean and banana. By checking the land use history, it was found that soybean was grown in paddy field after rice harvesting. And banana field was prepared from rice paddy. Those weed seeds may deposit in soil since time of rice growing, so at suitable condition they can germinate and grow up. So, knowing the land use history is very helpful to explain why some unusual weeds were found.

   3) **Date-month-year**: the date survey including name or names of surveyors. Date of survey indicates season of survey, how long ago, and which season the weed can be found

4.2 **Weed**

   1) **Weed species**: if possible scientific name should be noted. In case of unable to identify, the local name or name that people in the survey site call the weed. If both, scientific and local name are not known, it should mention as unknown, unknown 1, 2 …. Sample of unknown weed should be collected more than the known one for sending to plant taxonomist for identification and keep in herbarium.

   2) **Density or covering area**: knowing density or covering area of the weeds may able to analyze for level of infestation or predict infestation. As well it is hint for trend of weed infestation in the survey site too. Density / covering area cam be

collected by laying a square frame of 1x1 m. or 0.5x0.5 m., note for weed species and quantity of all weed found in the frame, then calculate for average of each field.

Calculating for covering area: using the same square frame but estimate covering area of each weed instead of counting. Covering area may define as percent of covering or score at various level, depending on the survey team defined. For example, level of coverage may divide into 7 levels as shown below.

Level of covering	% covering
5	75-100
4	50-75
3	25-50
2	5-25
1	1-5
few	<1
rare	<<1

3) **Others**: such as growth stage of weed, seedling, mature plant, flowering, vigor, damage sign from insect or pathogen. Including other information which should be noted for analyze later.

5. **Sample collecting**: since dry specimen is an evidence of present/not present of weed, as well examine for correction of identification. So, it is necessary to collect weed samples in the survey site, especially the unknown. If the unknown is not in flowering stage or no important character for identification, such as seedling stage, then the seedling should be collected and grow for more detail and identification as mentioned in manual of weed collection.

6. **Remarks for survey**: decide for planning of survey should consider on:

- time and period of survey: it should be done before farmer practice on weed control in the field. And if the survey can be performed at the flowering period of weeds, resulting in more possibility to identification including dry sample preparation.

- accessible to the sampling field: survey in rainy season may more difficult to reach the sampling site than others season.

- examine in the field can cause damage to production of the crop or not. Such as examine and sampling in paddy field at the time of flowering stage of the rice. Avoiding all activity which may cause in inverse impact on crop.

Chapter 3
General surveillance

General surveillance is a process of pest surveillance in an area that the information collected from the various sources be compiled and verified. The sources of information may from journal, document, report, annual reports of concern organizations, as well staff or person who concern with plant pest, including online database which can be access via internet, but it should be website of reliable organization.

The samples of website which can be access via internet are:

Germplasm Resources Information Network (GRIN) (www.ars-grin.gov/cgi-bin/npgs/html/index.pl). The web provides information about taxonomy of plants. It permits searches at family, genus and species levels, as well as for common names.

Global Invasive Species Programme (GISP) (www.gisp.org). This program is partnered by the Convention on Biological Diversity. The GISP website largely discusses invasive species in general terms and provides useful links, such as CBD website (<www.biodiv.org/programmes/cross-cutting/alien>) which has a number of case studies on a diverse range of invasive species, including those affecting agriculture. The data of the site less updated, but the data on 100 of the World's Worst Invasive Alien Species, which available at http://www.iucngisd.org/gisd/100_worst.php. And more information on invasive species is available at http://academic.sun.ac.za/cib/iasi/index.asp, Invasive Alien Species Indicator, which is free for registration and accessible. However, these webpages may change and update any time.

Hawaiian Ecosystems At Risk (HEAR) At: www.hear.org, provides information and resources to assist in management of exotic invasive species in Hawaii and the Pacific. The website contains links to a global compendium of weeds at <www.hear.org//gcw >. This compendium has unillustrated fact sheets containing what limited information has been collected to date. The sheets cover alternative names, pest status, origin, environmental extremes tolerated and whether or not the plants are cultivated. The HEAR website contains links to the report: 'Invasive species in the

Pacific. Technical review of regional strategy', produced by the South Pacific Regional Environment Programme (SPREP). This report reviewed the pests that posed threats to the Pacific region when written in 2000. See more at //www.hear.org/AlienSpeciesInHawaii/articles.

International Plant Protection Convention (IPPC) www.ippc.int/IPP/En/ default.htm: contains the International Standards for Phytosanitary Measures (ISPM) and links to other multinational plant protection organizations.

Species Specialist Group (ISSG) at: www.issg.org : the site has two useful products: a list-server of specialists; and the Global Invasive Species Database. ALIENS-L is an email list-server of the Invasive Species Specialist Group (ISSG) of the World Conservation Union (IUCN) Species Survival Commission, organized through the SPC. This is a discussion forum for any type of invasive organism and so the topics can be broad. This is an easy way to ask questions of an expert group. The Global Invasive Species Database provides information on species that threaten biodiversity, and covers both plants and animals. The database can be found at www.issg.org/database/welcome/

Landcare Research, New Zealand At: www.landcareresearch.co.nz/databases /index.asp: The database of this site is collection which include nematodes, arthropods, fungi and other pathogens, and plants that are native to New Zealand including weeds. The web is a source of data for identification and image of pest online.

Pacific Island Ecosystems at Risk (PIER) At: www.hear.org/pier/index.html: The website focuses on potentially invasive plant species that threaten Pacific island ecosystems. In addition, there is resource material, such as images and distributions of agriculturally important weeds.

PestNet At: www.pestnet.org: PestNet provides an email network similar to that of the ISSG but is more targeted at agricultural pests. Its purpose is to help plant-protection workers in Southeast Asia and the Pacific. The topics discussed commonly relate to pest identification, requests for specimens and methods of controlling pests.

Some more online database that provide information for plants in detail which useful for weed identification, eg

Plants of the world online. At www.plantsoftheworldonline.org/: database provides information on plants characteristic in detail including synonym, native and distribution. Moreover, images of plant and/or voucher specimens of some plants also available.

Tropical Forage. At www.tropicalforages.info/: the website provides both factsheet and key for forage plants, including images. Many of these plants are weed in cropping area.

Invasive Species Compendium – CABI or ISC CABI**.** At www.cabi.org/isc: database of invasive plants which many of them are weed. Data of each species consists of images, synonyms, common name and vernacular or local name of many countries, including description, distribution, control and management. The data provided in this database is very similar to Crop Protection Compendium – CABI (CPC-CABI) which need to be member for accessing, but ISC CABI is open to public.

It needs to keep in mind that all websites often update data and improve for more attractive and up-to-date, so the page and content may change any time, it may different from what mentioned here.

Chapter 4
Specific surveys

Specific survey is procedures by which (National Plant Protection Organization: NPPOs) obtain information on pests of concern on specific sites in an area over a defined period of time. It involves field work—going out and looking for the pests. So, all surveys in a specific area are specific survey. Those surveys may have different objectives but similar in survey method. Specific survey can be divided by their objectives as:

4.1 Detection survey: a survey conducted in an area to determine if pests are present. By definition, detection surveys include surveying to develop pest and host lists (where it is not known which pests are present), as well as surveying to support pest free areas (PFAs), pest free places of production (PFPP) or pest free production sites (PFPS). Detection surveys also include surveys of crops and forests for early detection of pests to minimize the chance of pest incursions and permit crop/forest management.

Detection surveys are possibly the most common surveys performed, involved looking for pests not known to be present. By the International Standards for Phytosanitary Measures No. 5 (ISPM 5), developed by the International Plant Protection Convention (IPPC), the definition is simply as "a survey conducted in an area to determine if pests are present". Therefore, any monitoring of the absence of a pest, is classed as a detection survey until the pest is detected

Detection surveys include surveying to develop pest and host lists (where it is not known which pests are present), as well as surveying to support pest free areas (PFAs), pest free places of production (PFPP) or pest free production sites (PFPS).

Detection surveys also include surveys of crops and forests for early detection of pests to minimize the chance of pest incursions and permit crop/forest management.

Pest lists for a host or location can be used in crop management to develop a baseline of pests present in a crop or at a site. Lists are also used in pest risk analyses that form part of the negotiations in accessing international markets. Host lists for targeted pests can provide information on alternative hosts. This can permit better pest management of crops if there are alternative host plants or sites that need to be dealt

with in nearby sites or verges. Th e knowledge of alternative hosts can be used to determine whether a pest could pose additional risk to other crops or native vegetation in the importing country. Steps for conducting detection survey for pest list are:

1) Identify commodity/crop

2) Determine contributors and budget.

3) Review any surveys in similar condition, reports, literatures (general surveys) about the crop, e.g. production site, cropping season, including weed list found in the cropping area or weeds found in the similar habitat nearby.

4) Identify survey area, method of survey, sampling method including data recording form.

5) Determine the time of survey

6) Perform survey, record weed species found and collect the weed samples in the sampling plot as planned.

7) data collections

8. Analyze data

9) Prepare report

Surveying for preparation of weed list of crops is a survey for weed database build up and utilization for international trading. So, the survey report does not report in form of density or covering percentage, but reports of relative frequency which calculate by the following formula:

$$\text{Relative frequency of A weed (\%)} = \frac{\text{(times of A weed recorded}}{\text{Total times of weeds recorded}} \times 100$$

4.2 **Monitoring survey:** ongoing survey to verify the characteristics of a pest population. It can apply where a pest is known to be present and the survey is planned to examine aspects of the pest population such as the prevalence of the pest and changes in prevalence over time. These surveys can be used to assist with pest management, monitor the pest which know to be present in the area, to examine how the population of the pest change, to prevent outbreak or reinfestation or eradicate

before it become severe outbreak or issue measurement to decrease risk of outbreak or re-outbreak. After control/eradicate measurement was issued, the monitoring survey must be performed again and again to examine that any remain or regenerate or not. If found, control/ eradicate measurement must be issued to achieve the objectives of control and eradicate.

4.3 **Delimiting survey**: survey conducted to establish the boundaries of an area considered to be infested by or free from a pest. The target pest of the survey is known. Objective of the survey is to clarify the boundary of infestation, how far it spread to obtain data for determination of management area of the pest.

Delimiting survey is also survey for confirmation of present / absent of the pest in the determination area, such as survey for a pest free area, survey for determine pest free site production. The assigned pest to be free in production site is specific pest that was defined by term of international trade. For example, exporting maize (ear) to Australia must be produced from witch-weed (*Striga asiatica* L.)-free area.

Before going out for pest survey in the field, it should be planed in advance since can yield data which able to determine the pest status and the plan should be flexible both practice and budget. The plan cannot be fixed exact number of pest samples to be collected. The good planning must select for transparent steps and plan. When planning at the first time, all detail about planning and explanation of principle and reason which will be useful for operator. However, when doing survey in the field, some may be changed from the working plan which need to record on explanation of cause and reason for changing from the primary plan.

Performing detection survey for invasive alien plant is a survey which cannot determine what plant species will be found but it can be determined the area for survey by pathway of introduction. For example: introduction of ornamental plant, the survey should be done in ornamental plant production area, ornamental plant market. Or if it was detected noxious weed seeds in vegetable seeds, then the survey should be perform and monitor in area where the seeds were grown, which the target weed species may be known by identifying from the seed. Before doing survey, all detail of the target species, such as plant character, seedling character, habitat which the plant prefers, manual or leaflet of target pest for field identification should be prepared. And educate all colleague on the survey should be done before starting the survey. Sometime,

questionnaire may be used to ask people in the area, clear images of the target pest is necessary and needed for explanation and questionnaire.

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