7. Potato seed system in Indonesia: A baseline survey

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Introduction

Like in other developing countries, the major constraint in potato production in Indonesia is the lack of good quality and cheap seeds. Government agencies, non-government organizations, and the private sector have attempted to produce seed potatoes in the last ten years. Involvement of the private sector in local seed production activities increased in the last seven years mainly due to the decline in seed imports to the country. The private sector invested very heavily in potato seed production by building net houses and tissue culture laboratories in potato producing areas of Indonesia.

Neither the private and the public sector however were able to produce seeds with adequate quality. Many of the private companies were unable to cope with the production costs and have terminated activities while a few are still struggling to survive . In some cases, private companies tapped government agriculture institutions to produce seeds but with limited success. Some companies opted to import seed potatoes from developed countries and multiply these locally to reduce costs and increase profits. Efforts by government agencies to develop individual farmer seed producers and cooperatives achieved limited success because the lack of funds constrained the former from providing adequate backstopping after the initial activities.

This study identifies and analyzes constraints in seed production in Indonesia. It describes the major factors that account for the failure to produce quality seed potatoes.

Methodology

Personal visits to different government and non-government agencies that collaborate and coordinate with the private sector to produce certified seeds were conducted. Among these institutions, those engaged in multiplication of seeds are the backbone of the system while the government and non-government agencies provide support or act in a regulatory function.

During these visits, interviews were conducted with technical and support staff, farmer-seed producers, and farmer-cooperative members. Facilities and techniques used in various stages of seed production and quality control were evaluated. Whenever possible, tissue culture production facilities (if available) or fields were observed and evaluated during the survey. Randomly selected farmers who were end-users of the seed production scheme, were also interviewed in West Sumatra, North Sumatra, West Java (Pangalengan district) and Central Java (Ngablak district).

Results

The criteria used by farmers to obtain seeds either from formal or informal seed sources in Indonesia are very similar to those reported in the Philippines. The major consideration is obtaining seeds from reliable sources – from wealthy farmers whose fields are situated in high elevation areas and who have built a reputation of producing good quality seeds. It is assumed that wealthy seed suppliers buy good quality seeds and regularly renew their supply (such as

through imports) to avoid degeneration of seed quality. The farmers also emphasized the importance of having good personal relations with the seed source to be guaranteed supply of quality seeds. Financial status of and good relationship with the seed source also enable the buyers to negotiate for a credit term where payment may be charged to the harvest.

A majority of farmers are willing to pay for expensive seeds as long as these are of good quality. They further believe potato tubers imported from other countries (whether certified or not) are of superior quality but lamented the fact that these usually end up with rich farmers who have more buying power compared to them.

None of the farmers interviewed had faith in the quality of locally produced seeds, with some complaining that these did not yield more than the potato they planted using their own seeds. A majority of locally produced seeds are not certified and are therefore not of good quality. Farmers usually realize that they planted poor quality seeds after one and a half months from planting but by then it is already too late to bring this up with the seed producer. Local seed producers also cannot provide the guarantee or the certificate of standard (certification) sought by the farmers. This despite the fact that some farmers consider the label on the seed box, which indicates that the item is imported, as a sufficient guarantee of its source and quality. Locally produced seeds therefore have very limited commercial potential since farmers believe and have proven for themselves that these are of poor quality.

Recently, farmers found that seed produced inside net houses (G^0) perform better than seed available in the market. Demand for tubers produced inside net houses increased and some of private seed growers focused on seed production of G^0 tubers of approximately size 15-30 grams/tuber for which farmers pay 700 rupiah apiece.

The major obstacle for developing a good seed system in Indonesia revolves around this single factor of quality. Farmers have lost faith in locally produced seeds since these are not certified and do not guarantee a good crop. Therefore there is no market for locally produced seeds. This is the reason why many private companies have shut down seed production operations.

Reasons why quality seeds cannot be produced in Indonesia

The major complaint about locally produced seed potato in Indonesia is its poor quality. The following factors were examined and analyzed to understand the reasons behind this:

Variety

The major potato cultivar grown in Indonesia is Granola and individual seed producers have also focused on Granola seed production. Although there were attempts to produce seeds of other cultivars, especially those suitable for processing, these failed because the products did not meet industry standards. Many individual seed growers even stopped producing seeds of processing varieties because requirements are not constant, and many a times, their contract with large companies to produce seeds was not honored by the latter.

In Indonesia, there are several types of Granola cultivars: Granola-L (Lembang), Granola-J, Granola-PO and many others. Granola-L was official released by the Indonesia Seedboard and is considered the official variety while the others are selections by different individual farmers or farmer groups. Granola-L performs relatively well under Indonesian environmental conditions in West Java (Lembang, Pangalengan), Central Java (Magelang) and North Sumatra although it has not adapted well in other localities. Granola seeds obtained from North Sumatra (unknown type Granola L, J or PO) were planted in West Sumatra and

found to be low-yielding (8 tons per hectare) and produced about 8 small tubers (< 30 g) per plant. The yield and the number of tubers are relatively constant across different generations of seed (G^0, G^1, G^2), an indication of poor adaptation of the cultivar to the locality. A farmer who plants seeds of this Granola type will definitely be disappointed with the yield because of the poor adaptation of the variety, rather than the health standards of the seed used. Further, there is no guarantee of varietal purity in the seeds available to the farmer.

In different research and educational institutions in the country, a sizable potato germplasm collection of different origins is available. It is not uncommon to find different types of Granola originating from different sources in these collections. They are freely distributed in the form of *in vitro*, stem cuttings, rooted cuttings or mini tubers.

It has been a practice in these institutions for lost accessions to be replaced by obtaining sprouts from field-grown tubers as the starting material for tissue culture. This has resulted in viral contamination of some of the Granola accessions available in these institutions. This material should not be used as starter material in seed productio schemes unless it is checked against virus contamination.

Seed multiplication field sites

Field multiplication of net house-produced G^0 tubers is an important step during seed production. During this stage, some contamination from pathogens is inevitable. Therefore all measures should be taken to prevent or reduce contamination during the multiplication stages to maintain quality standards. Since bacterial wilt and root knot nematodes are endemic in the potato growing regions of Indonesia, special precautions should be taken while selecting sites for seed multiplication.

Basic procedures have been developed and adopted by seed programs in developed countries for field multiplication stages. However these procedures have to be modified depending on the country and the infection pressure in a given locality.

None of the seed producers or institutions in Indonesia included in the study have taken adequate precautions to select suitable sites for field multiplication of potato seed. Instead seed growers relied on a general belief (not validated by experimental data) that recently cleared areas or patches of empty land within tea plantations are suitable for seed production. They ignore important information such as aphid population data, soil analysis, pathogen distribution, off-season and seasonal crops grown in the locality, history of crops grown, and others that are important in selecting a seed multiplication site. It is very common to find potato seed fields among Solanaceous crops such as tomato, pepper and eggplants. There are also instances where the different categories of seeds (G^1, G^2 and G^3) are multiplied in the same locality. Neither of these are appropriate practices for good seed production.

Some institutions select individual farmers to multiply G^3 that are then sold to other farmers. The selection process does not consider the location of the farmer's field and the incidence of pests and diseases in the area. A survey conducted in Center Java involving seed farmers belonging to a cooperative showed that over 90 percent of their fields were infested by root-knot nematode (see the paper by Suri and Jayasinghe in this volume).

Other important information such as topography of the land in relation to other farmer's fields, water source and possible contamination, wind direction, and road condition has also not been considered. Proper site selection for field multiplication of seeds has been extremely poor or nonexistent such that it is quite common to see seed fields with approximately 30 percent of bacterial wilt infection even under seed programs managed by government institutions at G^1 level. A seed multiplication farm belonging to a government agency that this researcher visited was 100 percent infected with bacterial wilt.

Seed crop management

In Indonesia there is no distinction between the management practices for a seed crop and a table potato crop. Plant-to-plant and row-to-row distance, frequency and application of pesticides, and all other agronomic practices conducted on a seed crop are similar to what is done for a table potato crop. Even farmers who have been trained in potato seed production do not practice the correct procedures. This may be because the same farmers produce different classes of seeds and in many cases also a crop of table potatoes. Crop management requirements for seed production differ from those of table crop production, but it is not convenient for a farmer to use different management practices in different locations of the same field.

Crop rotation reduces the inoculum build up of pathogens but only a few farmers practice it to a limited extent. Many farmer-seed producers who belong to cooperatives and who have small landholdings do not practice crop rotation because it is difficult to find an alternative crop which has as much value as potato.

Rouging, an important practice in seed production to maintain seed quality, is practiced only by a few seed growers, who usually just throw the infected plants into a corner of the seed field or to a nearby canal, raising the possibility of contamination. Even in government institutions where people have undergone special training, rouging is not practiced correctly.

Because of poor site selection for seed multiplication and poor management, locally produced seeds are usually not of the proper seed size and are heavily contaminated by pathogens, especially bacterial wilt and nematodes. Seeds produced in Pangalengan, West Java, was observed to be heavily infected by scab.

In Indonesia, efforts to train specialized seed producers have failed. Because of uncertainties in the seed market, farmers will always grow a table potato crop alongside a seed crop to guarantee income. This results in management practices suitable for the table crop to also be used for the seed crop.

Net houses and G^0 production

The number of net houses available for G^0 production in government organizations is rather limited. More often these net houses are also shared with other crops, thus limiting the number of G^0 tubers that are produced. The net house structures available in Indonesia vary from a simple net- or plastic-covered tunnel to sophisticated net houses imported from foreign countries. Many of these net houses are not suitable for G^0 production, especially those that are covered with transparent plastic sheets that trap air and heat, thus increasing the humidity within. On sunny days the temperature can reach above 40 degrees centigrade and the net house can get increasingly humid at night when water begins to condense. This condition triggers the development of late blight, which affected every net house visited by this researcher. In some institutions, excellent net houses have been built using bamboo.

There are many abandoned net houses scattered throughout the country, remnants of unsuccessful private sector involvement in seed production activities. Ornamental plants now occupy some of them but majority have been left to deteriorate.

Only two government institutions and one private company have attempted to produce G^0 tubers in raised beds to prevent contamination. In all others, the seedbeds were haphazardly distributed on the floor. The uneven distribution of the beds does not allow sufficient room for performing the different net house management practices in G^0 production

but instead encourages contamination. Sterilization of soil used in seedbeds for the production of mini tubers was not practiced except in a few government facilities. The soil mixture used ranged from pure rice ash to a mixture of sand and organic matter. Reusing the same soil mixture season after season was a very common practice that has contributed to contamination and spread of bacterial wilt within the net house. In net houses where there are no raised seedbeds, prevalent problems were damping off, bacterial wilt, and weeds.

The ideal planting materials that should be used in the net house to produce mini tubers are pathogen-tested *in vitro* plantlets. Stem cuttings may also be used provided they are obtained from virus-free in-vitro mother plants and are rooted according to strict sanitary standards. The ideal seed system is a flush out system but in Indonesia, none of the institutions or the private sector practiced this. Instead, they continuously use the same materials under the net house, further creating a favorable environment for contamination. Generally, net house management for G^0 production in Indonesia is very poor. Under the conditions in which the mini tubers are produced in Indonesia, they cannot be considered as G^0 according to international standards.

Tissue culture facilities

There are highly qualified tissue culture technicians in government research institutions and universities. Except for a few in the private sector, most of the technical staff only learned tissue culture through on-the-job training. In certain private sector operations, it was not possible to evaluate the tissue culture work because the personnel were not able to answer specific questions due to lack of knowledge about the subject matter. Tissue culture activities in Indonesia are mostly concentrated on ornamental plants, with potato only secondarily or as a curiosity.

A good collection of potato germplasm obtained from the International Potato Center and other sources is maintained in the country's research institutions. The majority in the germplasm maintained by the private sector are cultivars which are suitable only for processing.

Tissue culture work is hampered by lack of appropriate facilities. This also contributes to the production of low quality potato seeds. Contamination during tissue culture ranged from 20-60 percent mainly due to fungus, indicating poor performance of the laminar floor filter. Because of the high cost of laminar filters, some of the filters have not been replaced for more than 10 years. The high humidity and warm temperature favor the growth of molds, which are the sources of contamination during tissue culture work. It was a common sight to see a large number of bottles contaminated with molds waiting to be cleaned in the kitchens. Contamination increases the cost of production because to control it, inoculation chambers need to be installed with costly UV lights. Many inoculation chambers that this researcher visited either had no UV lights installed or if available, were not switched on when the chamber was not in use.

Despite being aware of sanitary precautions that should be taken during tissue culture work, many technicians do not follow these. Except for one institution that was included in the study, none had proper facilities for preparing the media, adequate chemicals, and sterilization equipment. The chambers for growing the plants were dark, with lighting only from a few fluorescent bulbs. In some cases the windows were covered with opaque material, resulting in very thin etiolated plants with poor growth, and in some cases, callus formation.

Tissue culture growth media includes stock solutions of different chemicals mixed in appropriate concentrations. This is useful in research but for large-scale production, it is difficult to adhere to the required media preparation, with the slightest variation definitely

leading to callus formation. Large-scale growers can use commercially available media in packet form for convenience and to standardize the media for tissue culture work. However, most of them think that it is costly when it is actually cheaper to use commercially available media to reduce labor cost, save time and be assured of proper growth.

Granola requires 22 days to grow to transplanting stage but in appropriate environmental conditions, it only takes less than 12 days to fully develop to this stage. Losses during transplanting are high due to poor vigor of the *in vitro* plants. The system established by the Bogor Agriculture University tissue culture laboratory for long distance transport is recommended to reduce losses.

Private sector seed producers agree that a tissue culture facility is a must for potato seed production but very few of them have taken advantage of existing facilities and technical capabilities of research stations and universities to obtain their *in vitro* requirements for seed production. Instead, they established their own facilities, majority of which are going to waste now.

Only a few end users who need potato *in vitro* plants are aware that they are available from the Research Institute for Vegetables (RIV) in Lembang and from Bogor Agricultural University. Further, there are many small and large private sector laboratories where tissue culture plants of potatoes are produced and waiting for clients. In North Sumatra, for example, growers complained that they were unable to buy *in vitro* plants from RIV, which is nearly 2,500 km away, when tissue culture plantlets were available at the North Sumatra Assessment Institute for Agricultrual Technology in Medan, less than 30 km from their location.

Many tissue culture conferences and congresses are often held in various cities. The interest in tissue culture is mostly because of the demand for planting materials of ornamental and woody plants and very rarely, for potatoes. Therefore these congresses are mostly directed towards these plants and are potatoes not included. This is one reasons why technicians who are engaged in tissue culture of potatoes rarely get the opportunity to exchange ideas with colleagues from other laboratories.

Seed storage

Seed storage plays a very important role in seed production. It not only allows handling of large quantities of seed until the planting time but also facilitates manipulation for the seed to achieve maximum physiological conditions needed for planting. However, losses can be high due to improper storage conditions and contamination with pathogens and pests. In Indonesia, only a government-run small cold (refrigerated) storage room may be said to be up to standards. A majority of the specialized seed growers practiced the same storage process as growers of table potatoes. They usually use a room or a dark shed to store seeds that are not even graded, washed or sorted. Most of them do not use racks but only heap the seeds into a corner.

The potatoes stored under these conditions showed rotting, damage due to rodents and long sprouts. Potato tuber moth was a problem in almost all the storage facilities that were visited. The survey showed a lack of facilities in Indonesia for proper storage of seeds. However, cold storage is not needed in Indonesia since the crop is grown year around. With proper handling and management, storage under ambient temperatures is adequate.

Seed certification regulations

Indonesia has seed certification regulations similar to those implemented in developed countries. The procedure requires the seed grower to obtain a certificate of cultivar purity from the breeder as the first requirement. This requirement is useful to protect the breeders' rights over the new varieties. However, for varieties which are now grown in Indonesia such as Granola, the plant breeders' rights of which have expired, it is difficult to get this certification. This requirement also hinders seed production activities if the breeder is not based in the country. Not complying with this regulation makes seed certification impossible, therefore majority of seed producers do not opt for seed certification since they are unable to comply with the regulations. The seed certification agency also considers seed production outside of the formal certification system as an illegal activity. Therefore quality control is not possible, resulting in poor quality seeds. All efforts should therefore be made to reexamine this regulation.

Discussion and Conclusions

The recent economic crisis in Indonesia significantly increased the cost of imported agricultural inputs, including quality seeds needed for potato cultivation. In response to this situation, many private companies and individuals invested in seed potato production but without much success. They failed mainly because of lack of market for their products as farmers were not convinced of the seed quality. Even in cases where private seed producers were able to produce good quality seed, regulatory requirements made it difficult or impossible for seed producers to obtain certification of quality from the government seed agency. Without this assurance farmers remained skeptical of the seed quality and refused to buy it.

Two institutions have greatly influenced seed production in the country: Bogor Agricultural University and the Research Institute for Vegetables in Lembang. These two institutions have conducted research and development in potato seed production. However, the efforts by these institutions have so farm not had much of an impact on the quality or quantity of potato seeds produced in Indonesia. Due to funding constraints, many of these activities stopped, leaving behind the facilities that were built especially for this purpose.

Seed growers sell what they refer to as certified seeds although these were not actually certified by the government. Because of this, farmers have lost faith in locally produced certified seeds. They do not see any advantage in using these over that which they select and set aside from their harvest. This situation has created a marketing problem for the seed producers. ELISA, a quality control measure in tissue culture, is generally not done except in the research institutions.

The initial *in vitro* plants used in seed production usually originate from the Research Institute for Vegetables in Lembang. However, tissue culture technicians in other organizations reintroduce field-grown or net house-grown materials as *in vitro* without proper procedures, resulting in contamination of the *in vitro* collections at other institutions.

To meet the requirements for certification, Granola has been released as Granola-L in Indonesia. Many farmers and groups have named varieties on their own in disregard of regulations, creating problems for the end user because some are not adapted to Indonesian conditions.

The involvement of the private sector in seed production activities in the country is a good development. However, their main interest is not to produce seeds of Granola but to

produce potato seeds of processing varieties such as Atlantic or Kennabec. Since these two varieties cannot be certified in Indonesia due to certification regulations (they have not been officially released), private companeis are reluctant to produce seeds in large-scale.

There are good technicians available for tissue culture work in the country. However they are mostly engaged in the production of ornamentals and forest trees. Except for RIV in Lembang, in all other institutions where tissue culture activities are performed, potato is of low priority.

The management of net houses during production of G^0 is poor. Since the international terminologies used in describing different classes of seeds are not strictly used, quality control standards are not met. There are also no precautions taken to prevent contamination except the application of fungicide to prevent late blight.

Selection of a proper site for the multiplication of G^0 tubers under field conditions has not been done. Even in government-run institutions, various classes of seeds (G^1 and G^2) are planted alongside each other. Most of the fields selected by the agriculture extension service for seed multiplication are heavily infected with bacterial wilt. There are instances where seed fields show bacterial wilt and scab presence. Crop rotation, rouging and other seed management practices are not followed by any of the institutions engaged in seed production. On the whole, the crop is managed as a table potato crop rather than a seed crop.

There are few cold storage facilities in Indonesia probably because potatoes are grown in the country the whole year. However, minimum facilities are needed to provide adequate conditions to initiate good sprouting.

Seed production should not be the responsibility of research institutes. Instead it should develop standard procedures, pathogen detection techniques and kits, quality-control standards that may be adopted by the production sector, and train personnel in seed production. Most of the problems associated in tissue culture work such as the formation of callus or poor management during net-house and field multiplication are due to the lack of standard procedures. The use of standard procedures will eliminate many of the problems associated with seed multiplication activities in Indonesia. At present RIV is performing a dual function both as a research and a seed production center.

In Indonesia all sectors or institutions needed for potato seed production are present and are managed by capable and highly qualified staff. The support staff should however be continuously trained in seed production.

Existing laws are not conducive to seed production in the country. Laws should encourage the participation of the private sector while agencies which control quality should emphasize product standards. Good product standards followed by seed producers will improve the quality of locally produced seeds and restore the faith of the farmers in the local seed production industry.

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