Collecting, Characterizing, and Maintaining Sweetpotato Germplasm in Indonesia

I. G. Mok and P. Schmiediche
International Potato Center (CIP), ESEAP Regional Office
Jalan Raya Muara, Cikaret, Bogor 16610, Indonesia

Introduction

Conservation of genetic diversity within a crop species is the basis of all variety improvement. However, if the improved variety replaces traditional farmers' varieties, as it often does, the result may still be genetic erosion. Therefore, collecting and conserving farmers' varieties is an essential activity before disseminating improved varieties. This would be especially the case in areas or regions where a wide range of genetic diversity exists. Indonesia, Papua New Guinea, and the South Pacific islands are generally regarded as the secondary center of genetic diversity of sweetpotato (Yen, 1974). In Indonesia, sweetpotatoes are cultivated in an array of agro-ecological zones, ranging from the humid tropics to sub-alpine cultivation areas higher than 3,000m above sea level. Based on phenotypic variations observed in farmers' varieties, it is assumed that a large amount of genetic diversity is still in existence on the Indonesian archipelago.

Conservation of germplasm has many components including collecting, documentation, characterization, evaluation, and maintenance. Systematic conservation of germplasm depends on proper documentation with passport and characterization data. Morphological characterization, along with molecular markers, helps to identify duplicates. The number of accessions for maintenance can be drastically reduced by eliminating duplicates (Huaman, 1992).

Collecting of sweetpotato germplasm by CIP's regional office for East Asia, Southeast Asia and the Pacific begun in 1990 in collaboration with Indonesian institutes. Due to the efforts of many organizations and financial help from CIP and the Swiss Development Corporation (SDC), we were able to collect sweetpotato germplasm throughout Indonesia. The collection has been morphologically characterized, and duplicates were identified. Evaluation focused on useful characteristics for crop improvement such as resistance to scab (*Sphaceloma batatas* Saw), flowering, and dry matter content. As part of the conservation effort, we divided accessions into several groups based on the evaluation results, and botanical seeds are now being collected for long-term conservation, using the polycross method.

Collecting farmers' varieties

The focus of conservation in Indonesia is the landrace or the variety grown by farmers over a long period of time. Farmers' varieties have been collected in a collaborative activity of CIP with a number of Indonesian institutes. An overview of the accumulated collection is presented in Table 1. Accessions were obtained through collecting trips to the main production areas. Figure 1 indicates the areas covered by the expedition teams. In addition, Institutes maintaining sweetpotato germplasm in Indonesia kindly donated some accessions. To select target areas for collection, the production statistics of the so-called *Kabupaten* (a political district in Indonesia) were

consulted at the databases of CGPRT in Bogor. Irian Jaya as whole, and Nias Island in North Sumatra have the highest acreage cultivated with sweetpotato. In both places, sweetpotato production is both for human consumption as well as pig feed. Therefore cultivars that produce high quantities of vine along with the good storage root production are the preferred genotypes in these areas. We collected throughout Java and Sumatra where sweetpotato is extensively grown. In Irian Jaya, the area around Lake Anggi and parts of the Baliem Valley were repeatedly visited by our collecting expeditions. Accessions from Bali and Sulaweshi were obtained from RILET and BIOTROP, two Indonesian institutions working with sweetpotato germplasm.

Stem cuttings were collected to avoid the spreading of diseases and pests through soil attached to storage roots. Also, stems were easier to collect and less bulky to transport. Five to ten cuttings, about 40 – 60 cm long, were taken from each collected accession. Morphological characterization of leaf, vine and storage root was done at the collecting site, using the "Descriptors for Sweetpotato" (CIP, AVRDC, IBPGR, 1991). This practice was helpful for obtaining preliminary data and for identifying accessions that had been accidentally mixed up. We organized the collecting team to include biological as well as social scientists. The social scientists interviewed the farmers to obtain indigenous knowledge and contextual data. Biological scientists collected germplasm and carried out the morphological characterization. During the expeditions to Irian Jaya, the interdisciplinary team was able to collect a large amount of farmers' varieties and to record farmers' knowledge related to these accessions (Schneider, et. al., 1993). The team approach also helped to obtain better insight into the relationship between tribal culture and cropping systems. Local names generally indicated the origin and usage of a variety. In some cases, different variety names turned out to have the same meaning in different languages or dialects (Mok and Schneider, 1994). Farmers' indigenous knowledge helped to identify characteristics such as taste, sweetness, and quality after cooking. Information on special usage, such as weaning food or certain medical use, was also obtained through the recording of indigenous knowledge (Prain, et al., 1995).

Morphological characterization and identification of duplicates

After a collecting trip, all accessions were planted in a screen-house to examine diseases or pests, and then, they were transferred to the field. Until the accessions were planted in the field, the collection number or donor's ID number was used for identification. Once clones were planted in the field for maintenance, the final accession number was assigned. Each accession was assigned a five-digit sequential number with an upper case initial which indicates its geographic origin (e.g., B for the general collection, S for Sumatra, M for Anggi-Irian Jaya, and W for Wamena-Irian Jaya). A passport data file was created that contained the accession number, the name of the collector or donor, the site of collection (province, district, village, altitude, longitude, and latitude), and the date of collection.

Morphological characterization has been carried out for all accessions maintained in our collection. Observations were made 80 - 100 days after planting. The shape of mature leaves, the pigmentation of the abaxial leaf, petiole pigmentation and length, vine internode diameter and length, vine pigmentation, plant type, leaf color, and storage root skin and flesh color were used as indicators. This method of morphological characterization was described by CIP, AVRDC, and IBPGR (1991). The color chart developed at CIP was used to record storage root skin and flesh color. The characterization was continued in the second and third season in the field where

all accessions were planted in groups according to the morphological characterization carried out in the previous season. This grouping had resulted from a sorting of the data files according to nine major characteristics. Like this, accessions that resembled each other, were planted side by side to facilitate further comparison. After 3-5 seasons of this type of morphological characterization, accessions with the same morphology were assigned a group number.

Field resistance to scab was recorded, using a rating system from 0 to 4. Flowering intensity under field conditions was also recorded. These characteristics were most useful for the confirmation of duplicates after initial grouping according to morphological characteristics had been carried out. Additional analysis of biochemical markers, such as isozymes, RFLPs, or RAPDs, that had been conducted in CIP laboratories in Lima, confirmed the precision of morphological characterization as a reliable tool for the identification of duplicates (Huaman, pers. comm.). All descriptors used for the morphological characterization were recorded in database files as digital codes (CIP, AVRDC, and IBPGR, 1991), and all information collected was stored in a computerized database.

Files were prepared for passport data, morphological characterization, disease resistance, physiological evaluation, and some other information. These individual files were linked, and it became thus possible to select accessions for any combination of desired data.

Because of the distinctness of the sweetpotato germplasm from Irian Jaya, it was maintained and treated in a separate group, and for convenience sake it will be referred to as the Irian germplasm. The genetic material from the rest of Indonesia is referred to as the Muara germplasm because it is principally maintained and evaluated at the Muara Experiment Station in Bogor, West Java. Duplicates were first identified in the Muara germplasm, and as indicated in Table 1, about 40% of this collection were duplicates whose initial identification was based on nine morphological characters as well as flowering intensity, and resistance to leaf scab. Finally, the collecting site, as recorded in the passport data, was used to ensure that accessions, which were collected at distant locations but identical to others according to morphological characterization, were not eliminated.

The Irian germplasm was maintained at the mid elevation Horticultural Research Station, Lembang, where temperatures range from 16-22^{o}C as this material had been collected in the Irian Jaya highlands. The morphological characterization of this set of accessions has not yet been completed. However, preliminary results indicate that there are not many duplicates in this set. When the accessions were collected by a team led by Dr. Jürg Schneider, a method of intensive interviews, to record the indigenous knowledge related to this material, were conducted with the farmers who provided it (Schneider, et. al., 1993). The recording of indigenous knowledge might therefore be an early opportunity to eliminate duplicates while collecting germplasm.

Utilization of collected germplasm

As the number of germplasm accessions increased, systematic evaluation was started in the Muara Experiment Station in Bogor. The evaluation concentrated on resistance to scab and weevil (*Cylas formicarius*). All of the accessions were tested for their adaptability to low fertility soils because sweetpotato is, in general, grown with very

low input in marginal soils. Recent development in the carbo-chemical and food processing industry in the East and Southeast Asian countries required the selection of varieties with high dry matter content. All of the accessions, which produced acceptable storage root yield, were evaluated for their dry matter content. As a result, many highly useful accessions were identified and used for further selection and breeding.

Yield and dry matter content The Muara germplasm (maintained at Bogor) and the Irian germplasm (maintained at Lembang) has been harvested several times since its initial collection. At Bogor, the material was harvested 5 months after planting, while at Lembang, harvest took place 6 to 7 months after planting. At harvest, accessions with acceptably high yield were selected and their data recorded. Only these selected accessions were further analyzed for their dry matter content. The results of this process and the ensuing analyses are presented in Table 2-1. Most accessions had dry matter contents in the range of 25 - 35%, a few had more than 35%. Since the Muara and the Irian germplasm had been planted at different locations, direct comparison was not possible. Among the Muara accessions, some clones had a dry matter content of about 40%, while producing reasonably high yield at the same time. These clones will become important materials for the breeding program for high dry matter content. Many of the Irian accessions did not produce storage roots when first planted at Lembang immediately after their collection. It was, however, interesting to note that more and more accessions started to produce storage roots after 2 to 4 clonal generations in Lembang. At this point of our research, it is hard to explain why this would have occurred.

Resistance to leaf scab Field resistance to scab was assessed by scoring the symptoms on a scale from 0 (no symptom) to 4 (severe infection). It was relatively easy to assess resistance to scab disease at Bogor and Lembang as high humidity is prevalent throughout the year in West Java, Indonesia, and scab is proliferating where rain is frequent. Observations for scab resistance were carried out 7 times for the Muara germplasm. From those 7 observations, the highest scores were used for presentation in Table 2-2. The results for the Irian germplasm, however, are based on only one observation (data were collected through multiple observations, but they have not yet been processed). Therefore, the resistance observed in the Irian germplasm could be over estimates. Even so, it appeared that the Irian germplasm was more resistant to leaf scab than the Muara germplasm. It is highly probable that Irian farmers have selected accessions that were at least not susceptible to this disease since they are cultivating sweetpotato as staple and animal feed in high land areas (1,500 - 3,000 m asl) where it rains throughout the year (about 1,700 - 2,000 mm).

Similar results were obtained in the Muara germplasm which included some accessions from Irian Jaya. The proportion of resistant vs. susceptible accessions varied according to the geographical area of origin. The reaction to scab, and the place of origin in the passport data, were linked and compared for their percentage in each reaction category (e.g., HR, R, MR, S, and HS). The results indicated that there were two types of geographical provenance in terms of resistance reaction. The first group, categorized by a lower percentage (<10%) of HR clones, included West Java, Central Java, East Java, Bali and West Sumatra. The second group, which had more than 15% of HR clones, included North Sumatra, Sulawesi, and Irian Jaya. When putting HR and R clones together, the first group had less than 30% and the second more than

50%. This may be due to selection pressure exerted on the crop during its evolutionary process. Two hypotheses could be considered to explain this grouping. One is that the first group originated in areas where there has not been much natural selection pressure by the scab disease. The second hypothesis is that the grouping was enhanced by cultural practices of farmers, e.g., avoidance of cultivation during the rainy season. There are indications that most of the sweetpotatoes grown in the first group of provinces was produced on a commercial scale, while most of the crop in the second group of provinces was produced by subsistence farmers (Mok, 1996).

Flowering ability There was no difference in flowering intensity and frequency distribution between the two groups of germplasm. The results of flowering observations are presented in Table 2-3. Forty percent of accessions collected did not flower under natural conditions. Although only 12% flowered profusely, almost 60% of the accessions flowered to a larger or lesser degree. Many of the non-flowering clones could be induced to flower through grafting or short-day treatment. Some clones would readily flower when their main vines were trained up on stakes. This means that most of the accessions assembled in the two collections can be utilized as parental clones in a breeding program. The intensity of flowering was very much dependent on the genotype which was another excellent indicator for duplicate identification, in addition to morphological characterization.

Other characteristics Accessions from Irian Jaya generally lacked orange flesh color. (Table 2-4). Considering that sweetpotato is a staple in Irian Jaya, the deficiency of beta-carotene in non-yellow cultivars may cause health problems related to vitamin A deficiency. There was a tendency that Irian germplasm generally lacked pigmentation on abaxial vein or main vine. Irian germplasm, however, had a higher proportion of spreading plant types than the Muara germplasm. Petiole length and vine internode were longer in the Irian accessions. In general, Irian accessions had more vines than Muara accessions. In terms of genetic variation, it is still too early to reach any conclusions. Collections in Irian Jaya were from limited areas (see the map in Figure 1). However, judging from the morphological variation observed until now, it might be true to say that Irian germplasm has less phenotypic variation than Muara germplasm.

The breeding value of Indonesian germplasm

We found, among the Muara germplasm, many accessions had a high dry matter content. The accessions in Table 3 were selected based on the performance at least more than two seasons. Each season, accessions were first selected by yield, then by dry matter content. These accessions were not extremely high in dry matter content when compared to some introductions of germplasm (especially from Japan), but they demonstrated a good yield potential in Indonesia. The accessions B0097 (BIRU), B0433 (KAPAS2), B0365 (unknown), S0034 (unknown), B0230 (unknown) were consistently high in yield and dry matter content over 2-4 seasons. These accessions have an advantage when selecting locally adapted varieties for processing or table use. Also, there was great phenotypic variation among the Muara germplasm. Consequently, it will be possible to select the desired genotypes for storage root shape, and skin and flesh color according to the needs and preferences of the end user.

There were many accessions in the Irian germplasm which were highly resistant to leaf scab, constituting a useful gene pool. The indigenous knowledge recorded during

the collecting expeditions indicated that farmers in Irian Jaya are using some specific varieties for baby food, general human consumption, and feed for pigs (Schneider, et. al. 1993).

Strategy for maintenance

Sweetpotato germplasm could be conserved as ex situ field collections or as in vitro collections. Either of these two methods requires significant investment in time and money. Field maintenance has the advantage that germplasm can be constantly evaluated for the different characters of importance to breeders and end users. However, this method is also more likely than in vitro conservation to result in losses due to disease, pest, drought, lack of adaptability, frost, or flood, and secure long-term conservation is only partially assured. In vitro conservation guarantees security but may result in somatic mutations, and cost for long-term conservation is, as a rule, higher than many National Programs can afford. In Table 4, the advantages and disadvantages of the different conservation methods are illustrated.

Sweetpotato accessions can be divided into three distinct groups based on current usage for which different conservation methods could be applied as discussed during the Workshop on the Formation of a Network for the Conservation of Sweetpotato Biodiversity in Asia, which held at Bogor in 1996 (Rao 1996). For example, the accessions most frequently utilized in a breeding programs could be maintained in an ex situ field gene bank for ready access at all times while the less frequently utilized accessions could be conserved in vitro. There are, however, also those accessions that have never been utilized following their collection and evaluation. The absence of use now does, of course, not imply that the genes present in them will never be needed at a future date. These accessions are therefore natural candidates for seed conservation.

Sweetpotato is a hexaploid crop, and there are not many research results available that sufficiently elucidate the genetic consequences of the complex segregation ratios associated with a hexaploid crop. Mok and Schmiediche (1996) discussed the genetic consequences of converting a clonally propagated hexaploid crop to botanical seed for long term conservation. The genetics of the sweetpotato, a hexaploid, is very complicated, and it is therefore difficult to predict the genetic consequences after random pollination among selected clones in a crossing plot. The complexity is caused by hexasomic segregation ratio, complex inter- and intra-locus interaction, double reduction, and ambiguity in genomic constitution.

The question in seed conservation of sweetpotato is whether the allelic array in hexaploids will be maintained intact after one generation of a sexual cycle. To answer this question, a simple simulation was conducted based on a few assumptions (Mok and Schmiediche, 1996). The result indicated that when a genotype had a low allelic number (di or triallelic), hexaploidy was a good genetic mechanism to keep the allelic diversity intact even with sexual reproduction. However, when the allelic constitution was penta- or hexaallelic, a higher degree of allelic combination was easily broken down by the formation of gametes. Therefore, genotypes with a low allelic number will be no problem for seed conservation. Even after one cycle of sexual generation, most alleles were maintained intact. On the other hand, genotypes with penta- or hexaallelic loci were easily broken up. Unlike in alfalfa (Busbice and Wilsie, 1966) or potato (Mendiburu and Peloquin, 1970), there is no information about the allelic structure of sweetpotato. Electrophoretic or molecular markers will provide a clear

understanding of the allelic diversity of selected loci. It will take a substantial amount of time to answer these questions. The problem is that nobody in the whole world is at present working on this subject mainly due to the lack of support to fundamental research in sweetpotato.

For the time being, keeping these limitations in mind, we had to develop a strategy to conserve invaluable genetic resources for future use. The first priority was a careful evaluation of existing accessions. Sweetpotato clones with high vigor, yield or at least one desirable character had to be maintained vegetatively. These clones are likely to have a high allelic number on the loci in question. Based on these considerations, we made a decision on which clones to keep either in ex situ field genebank or to convert into botanical seed for long term conservation. Accessions to be conserved as seed, were divided into several subsets for seed production in polycross nurseries. The subsets included high yield, high dry matter content, scab resistance, dark flesh color, good flowering, and some accessions from Irian Jaya. Each subset contained 80 to 100 accessions. Open-pollinated crossing blocks were set up with stakes to induce flowering and to facilitate insect pollination. All seeds collected were kept in an air-tight box with silica gel. A part of the seeds collected will be conserved at CIP, Peru and the rest will be conserved by an Indonesian institute as source material for breeding, genetics, and seed physiology research. These seeds could be used as an important source of genes for genetic manipulation in the future. The seed population will represent the genetic diversity of sweetpotato in Indonesia which is known as the secondary center of genetic diversity of this crop.

Summary

From 1990 to 1996, sweetpotato germplasm was collected from various regions of Indonesia. Until now, more than 1,200 accessions have been collected in collaborative efforts of Indonesian institutes and CIP. All accessions have passport data which include accession number, variety name, collector's (or donor's) name, and the collecting site with details on location, latitude, longitude, altitude, and collection date. Most accessions were morphologically evaluated according to CIP-IPGRI descriptors. Duplicates were identified based on morphological characterization, flowering intensity, and resistance to leaf scab. Finally, information on the collecting site in the passport data was used to ensure the maintenance of accessions which were collected at distant locations, even if they were identical each other according to morphological characterization. About 40% of the collection were duplicates.

Extensive evaluation was carried out for scab disease resistance, flowering ability, yield potential, and dry matter content. Many accessions with high dry matter content and good yield potential were identified, and many of them had consistently high in yield and dry matter content over 2-4 seasons. Large phenotypic variation was also observed among the Muara germplasm which was collected across the Indonesian archipelago except Irian Jaya. Consequently, it will be possible to select desired genotypes for storage root shape, skin color, and flesh color.

The most important accessions are maintained in the field for constant evaluation and use in breeding programs in Indonesia. Seed conservation for long term storage of selected accessions is under progress. These accessions were divided into several subsets for seed production in polycross nurseries. The subsets include accessions with high yield, high dry matter content, scab resistance, dark flesh color, good

flowering, and some accessions from Irian Jaya. Each subset, containing 80 to 100 accessions, was open-pollinated in isolated crossing blocks. Seeds collected are kept in an airtight box with silica gel. A part of the seeds collected will be conserved at CIP, Peru, and the rest will be conserved by an Indonesian institute as an important source of genes for breeding and genetic manipulation in the future. The seed population will represent the genetic diversity of sweetpotato in Indonesia which is known to be the secondary center of genetic diversity of this crop

Literature cited

Busbice, T.H. and C.P. Wilsie. 1966. Inbreeding depression and heterosis in autotetraploids with application to *Medicago sativa* L. Euphytica 15:52-67.

CIP, AVRDC, IBPGR. 1991 Descriptors for Sweet Potato. (ed.) Huaman, Z. IBPGR, Rome, Italy. 134 p.

Huaman, Z. 1992. Morphologic identification of duplicates in collections of *Ipomoea batatas*. CIP Research Guide 36. International Potato Center, Lima, Peru. 28 p.

Mendiburu, A.O. and S.J. Peloquin. 1970. Synthesis of tetraploid potatoes by interdiploid matings. Amer. Potato J. 47:357.

Mok, I.G. 1996. Screening sweetpotato germplasm for field resistance to scab (*Sphaceloma batatas* SAW.). HortScience 31:612.

Mok, I.G. and P. Schmiediche. 1996. Genetic consequences of germplasm conservation by seed in sweetpotato. pp. 93-99. In: V. Ramanatha Rao (ed.). Proceedings of the Workshop on the Formation of a Network for the Conservation of Sweetpotato Biodiversity in Asia., CIP -IPGRI, Bogor, Indonesia, 1-5 May 1996. 128 p.

Mok, I.G. and J. Schneider. 1994. Collection and Documentation of Sweet Potato Germplasm: Methodological Experiences in Indonesia. pp. 141-158. In: Prain, G.D. and C.P. Bagalanon (eds.) Local Knowledge, Global Science and Plant Genetic Resources: Towards a partnership. Proceedings of the International Workshop on Genetic Resources. UPWARD, Los Banos, Philippines. 320 p.

Prain, G.D., I.G. Mok, T. Sawor, P. Chadikun, E. Atmodjo, and E.R. Sitmorang. 1995. Interdisciplinary collecting of *Ipomoea batatas* germplasm and associated indigenous knowledge in Irian Jaya. pp. 695-711. In: Guarino, L. and V.R. Rao (eds.). Collecting plant genetic diversity: Technical guidelines. Wallingford (UK). CAB International; International Plant Genetic Resources Institute (IPGRI); FAO; IUCN; UNEP. 1995.

Rao, V.R., (Editor) 1996. Proceedings of the Workshop on the Formation of a Network for the Conservation of Sweetpotato Biodiversity in Asia., CIP-IPGRI, Bogor, Indonesia, 1-5 May 1996. 128 p.

Schneider, J., C.A. Widyastuti, and M. Djazuli. 1993. Sweetpotato in the Baliem valley area, Irian Jaya. A report on collection and study of sweetpotato germplasm, April-May 1993. CIP. 54 p.

Yen D.E. 1974. The Sweet Potato and Oceania. Bernice P. Bishop Museum Bulletin 236. Bishop Museum Press, Honolulu. 389 p.

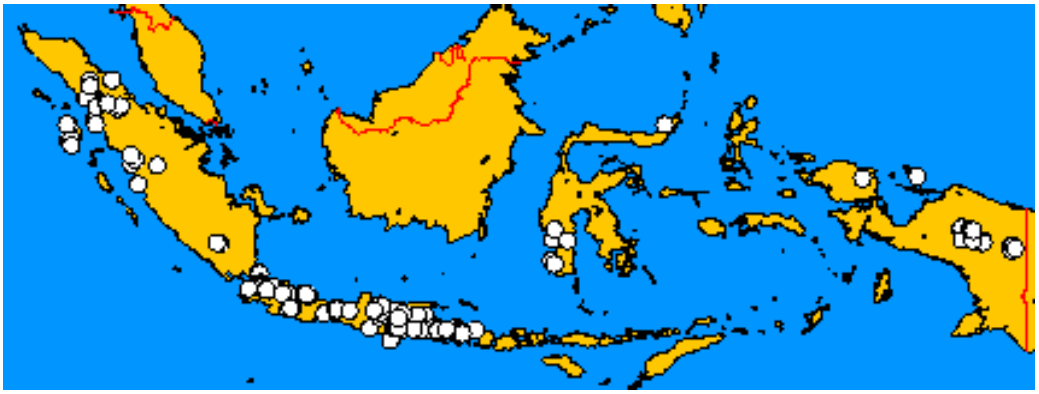

Figure 1. Sites of collecting sweetpotato germplasm in Indonesia. This map was generated by MapQuest through Internet.

Table 1. Number of sweetpotato accessions collected in Indonesia, and presently under conservation at field after eliminating duplicates.

Province of origin	Accessions collected	Duplicates	Accessions maintaining
Java	346	136	210
Sumatra	274	121	153
Kalimantan	0	0	0
Sulawesi	61	20	41
Bali, Nusa Tenggara	113	17 + ?	96
Irian Jaya	450	15 + ?	435
Total	1244	309 + ?	935

Table 2. Frequency distribution of Muara and Irian Jaya sweetpotato germplasm for important characteristics.

1) Dry matter content of clones selected based on yield.

DM%	Muara Germplasm				Irian Jaya Germplasm	
	Frequency January 95	Frequency May 95	Frequency October 95	Frequency September 96	Frequency June 96	Frequency December 96
≤20.0	2	4	3	0	1	1
20.1 - 25.0	15	32	13	3	1	1
25.1 - 30.0	65	96	66	17	15	19
30.1 - 35.0	34	64	77	13	26	59
35.1 - 40.0	2	37	15	3	9	22
≥40.1	1	6	2	0	0	0
Total	119	239	176	36	52	102

2) Resistance to scab disease (*Sphaceloma batatas*).

Score	Definition	Reaction	Frequency Muara GP[1]	Frequency Irian Jaya GP[2]
0	No symptom	Highly resistant (HR)	125	301
1	1-5 stems infected in a plot of 20 plants	Resistant (R)	45	61
2	Many plants infected slightly (5-10% of leaf area)	Moderately resistant (MR)	87	12
3	All plants infected moderately (11 - 25% of leaf area)	Susceptible (S)	104	6
4	All plants infected severely (>25% of leaf area)	Highly susceptible (HS)	118	1
	Total		479	381

[1] The maximum value of scab field resistance from seven observations between February - May, 1991.
[2] From the observation on July 12, 1995.

3) Flowering intensity

Score	Definition	Frequency Muara GP[1]	Frequency Irian Jaya GP[2]
0	No flowering	204	148
1	1-3 plants flowering within a plot of 20 plants	117	58
2	Most of plants with 1-3 flower	93	49
3	Most of plants with 4-7 flower	44	45
4	All plants flowering profusely	21	81
	Total	479	381

[1] The maximum value of flowering from seven observations between February - May, 1991.
[2] From the observation on July 12, 1995.

4) Storage root flesh color, predominant color

Score	Definition	Frequency Muara GP	Frequency Irian Jaya GP
1	White	202	27
2	Cream	85	176
3	Dark cream	0	26
4	Pale yellow	99	87
5	Dark yellow	18	41
6	Pale orange	34	6
7	Intermediate orange	31	3
8	Dark orange	12	1
9	Strongly pigmented with anthocyanins	5	6
	Total	486	373

Table 3. Selected accessions from Indonesian germplasm for high dry matter content and high yield potential.

Accession Number	Variety	Weevil infection %	Total yield Sep 96 Kg/2m^2	%DM Jan 95	%DM Mar 95	%DM Oct 95	%DM Sep 96
B0097	BIRU	27.8	4.2	32.6	38.5		36.6
B0126	KALI URANG	7.1	4.1			25.8	36.6
B0433	KAPAS 2	8.0	2.9	36.9		36.5	35.1
B0160	unknown	0.0	2.2		32.7		34.0
Check	BIS 183	0.0	1.2	32.7	27.9	30.2	32.8
B0365	unknown	25.0	3.3	30.9		31.2	32.0
B0367	unknown	0.0	2.1	28.6	28.0	31.3	32.0
B0408	unknown	23.5	2.2			30.0	31.9
S0034	unknown	7.1	4.2	31.4	31.2	31.4	31.6
B0230	unknown	43.6	7.0		32.8	31.4	31.4
Check	SQ 27			33.6	29.4	34.6	31.0
S0171	GOWI TUMBA	12.5	3.9	26.7	29.8		30.5
S0068	unknown	12.0	2.8	26.2			30.4
S0115	GOWI PKK	30.6	4.0	30.5			30.1
B0460	unknown	0.0	2.9			29.9	29.9
S0097	unknown	48.2	4.9		33.4	28.2	29.7
S0150	GOWI LAMBU	0.0	3.1	28.3	29.3	29.0	29.5
B0061	NO.40	20.0	2.8	25.3	26.2		28.6
S0192	GOWI HULO	42.9	5.2	27.6	31.9		28.5
B0568	TAMBURIN MERAH	32.3	4.0	37.4			28.3
B0480	MUNTUL IR 40 HA	38.9	4.3	26.8	29.8	29.1	28.2
B0430	KELENENG 2	16.7	3.2			32.6	27.4
S0083	GOWI RAHA 2	57.1	4.7	28.2			27.3
B0361	TAIWAN 395/6	26.3	5.3		27.5	26.4	27.0
S0128	GOWI SAYOLEHE 1	19.1	2.8	21.3	23.9		26.8
B0195	CEPROK	31.3	3.2		27.8	31.8	26.7
B0263	PELO RACIK	31.8	3.0		28.1	26.6	25.4
B0485	MARKONAH	23.5	2.9	27.5	24.4	22.8	25.2

Table 4. Advantages vs. disadvantages of different conservation methods for sweetpotato germplasm.

Conservation method	Utilization (Evaluation)	Genetic stability	Keeping true to type	Durability	Cost
Active field collection	+++	++	+++	-	+
Tissue culture	++	+	+++	++	-
Seed family	-	+++	-	+++	+++

+++ ideal; ++ good; + fair; - poor