

PLANT QUARANTINE FACILITIES DEVELOPED AT ICRISAT FOR EXPORT OF GERmplasm //

B. K. VARMA AND UPENDRA RAVI

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru (Andhra Pradesh)

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) at Patancheru, Andhra Pradesh, is a world centre for the improvement of grain yield and quality of sorghum, pearl millet, chickpea, pigeonpea and groundnut crops which are predominantly grown in semi-arid tropics, mostly under rainfed conditions, by subsistence farmers. Since the majority of research work on the improvement of these crops has been limited to temperate and developed countries with a few exceptions in the tropics, ICRISAT's mandate is to explore the potential of these crops, under semi-arid conditions. Better yields enable farmers of the semi-arid regions to profit from their cultivation and at the same time help to make developing countries self-sufficient in food.

Seeds play a vital role in the production of food. The need to increase food production rapidly has necessitated the ICRISAT scientists to exchange of germplasm frequently with many countries for the purpose of collection, breeding and distribution. The quantity of seed exported since the inception of ICRISAT (Table 1) shows the magnitude of effort made in this direction. Since 1974, 4,20,040 seed samples and other plant materials have been exported to scientists all over the world, who are also interested in the development programmes of ICRISAT's five mandate crops.

With the progress of research at ICRISAT, there has been substantial export of seeds of different crops during the last eight years (Fig. 1). Importing seeds involves the risk of introduction of insect pests or nematodes, pathogens and weeds which are sometimes carried unnoticed by them between countries. The international spread of harmful species of insect pests, nematodes, bacteria, and viruses can prove dangerous to crops in countries where these may acquire epidemic status. To cite a few examples of exotic pests: pink bollworm (*Pectinophora gossypiella* (Saund.)), khapra beetle (*Trogoderma granarium* (Everts)), and lesser grain borer (*Rhyzopertha dominica* (F.)), smuts of sorghum and millets, bacterial diseases of vegetable crops, and rust and viruses of groundnut that were carried inadvertently through seeds, have now become established in the country of introduction, causing great economic losses to agriculture. Such being the case, a realistic and an efficient

system has been implemented by the Government of India for the exchange of ICRISAT germplasm to prevent entry or export of injurious pests and diseases.

The Government of India has permanent Plant Quarantine and Fumigation Stations at all the international air and sea ports in India to enforce the plant quarantine rules and regulations of the country. ICRISAT being in the hinterland, a special arrangement has been made for examining and clearing imported seed materials as well as those meant for export, through the Central Plant Protection Training Institute (CPPTI), located in Hyderabad. This organization is a part of the Directorate of Plant Protection, Quarantine and Storage, Ministry of Agriculture, which is directly responsible for the implementation of plant quarantine laws and their enforcement.

The present arrangement for the entry of ICRISAT seeds and plant materials and their export can be better understood from Fig. 2.

The imported seeds of sorghum, pearl millet, chickpea, pigeonpea and seedlings of groundnut released by the national plant quarantine staff at CPPTI are planted in their presence in the Post Entry Quarantine Isolation Area (PEQIA) at ICRISAT. The PEQIA measuring 6 ha. is situated in one corner of the 1394 ha of ICRISAT land. It is surrounded by 45 ha of uncultivate land more than 200 m away from the nearest crop area.

The crops in the PEQIA are jointly inspected regularly (twice a week), by Government quarantine officials and ICRISAT plant quarantine staff throughout the growing period until harvest. Any unhealthy or diseased plants, as and when observed during the course of inspection, are promptly rogued and burnt. Every effort is made to grow pest-and disease-free crops in the PEQIA, and only seeds from healthy looking mother plants are harvested in the presence of CPPTI quarantine staff. These seeds are released then to ICRISAT scientists to be grown in the main ICRISAT crop area for breeding, multiplication, etc.

Just as ICRISAT receives seeds from foreign countries, it also despatches seeds to the semi-arid regions of the Indian sub-continent, South and East Asia, Africa, the middle East, and

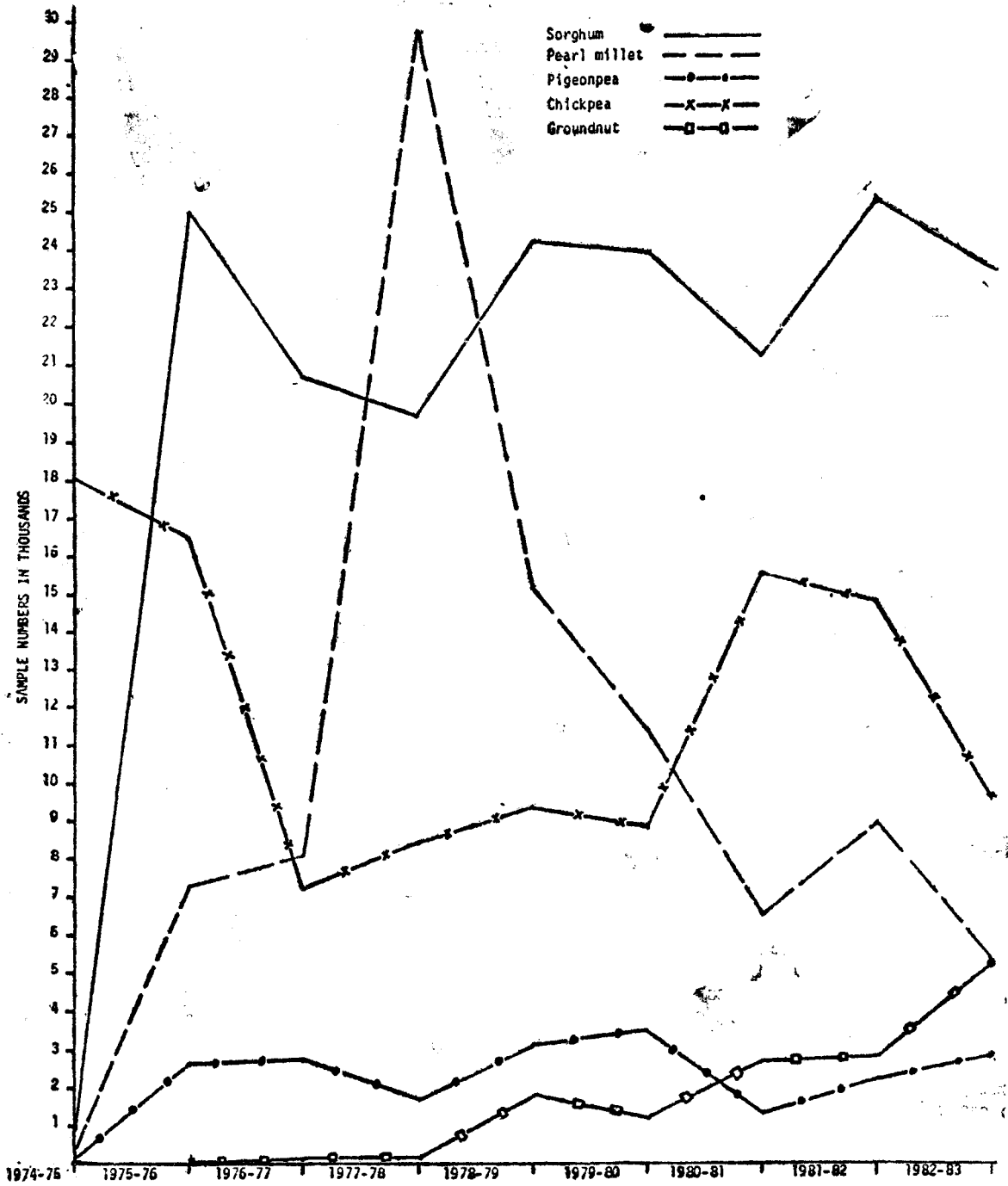


Fig. 1 Export of seeds and plant materials for 1974 June to 1983 May

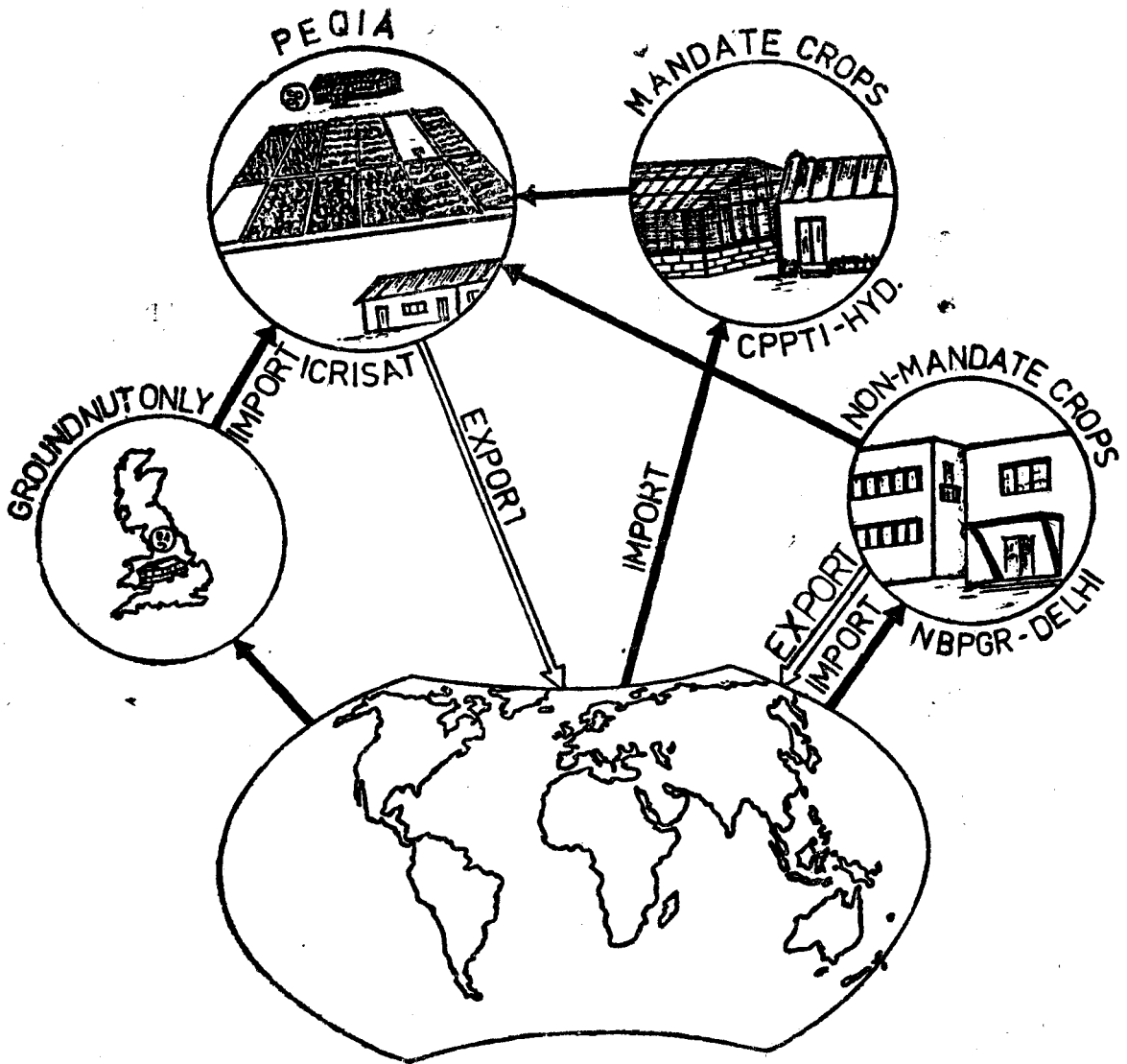


Fig. 2 Flow diagram of exchange of ICRISAT germplasm

Latin America. ICRISAT is committed to working in close collaboration with national and international scientists in other countries; to support multilocational trials and nurseries for screening and generating breeding material that combines high yield potential with resistance to pests and diseases, to breed hybrid and ordinary cultivars that are tolerant to environmental stresses, such as drought, and to develop short duration types that have higher protein content and better food quality.

The crop areas from which seeds are collected for export are inspected regularly by the plant pathologists and entomologists working on the crops to meet the requirements of the additional declarations, if any, of the importing country. The seed crops are kept free from pests and diseases, as far as possible, by undertaking plant protection measures regularly and promptly. Seeds thus collected from healthy plants are sent by ICRISAT program scientists to the ICRISAT Plant Quarantine Unit for examination, treatment (if necessary), and despatch to consignees.

Seed export from ICRISAT started in 1974. The requirements as laid down by the FAO/Plant Protection Convention 1951 for the issue of a Phytosanitary Certificate for export of seeds are strictly adhered to. The Government of India has established an export certification laboratory at ICRISAT, controlled and supervised by the national plant quarantine staff at CPPTI for the expeditious movement of germplasm to foreign countries. ICRISAT provides the laboratory facilities and support staff who carry out the initial operations for preparing the seed for export. The inspection and testing procedures are briefly described below.

The Export Certification Quarantine Laboratory (ECQL) is fully equipped with a fumigation chamber, radiography, an incubation room with control Near Ultra Violet Light (NUVL), temperature and humidity according to DGISP* standards, entomology and plant pathology laboratories, and rooms for receiving, cleaning, inspection, treatment and packing, etc. The laboratory is manned by well-qualified scientists including two entomologists, four plant pathologists and one fumigation assistant, and other support staff. The work of the laboratory is supervised by a Chief Plant Quarantine Officer.

Fumigation.—As soon as any seed consignment is received at the Plant Quarantine Unit, it is subjected to fumigation with methyl bromide, with the exception of groundnuts for which aluminium phosphide fumigant is used. There is a vacuum fumigation chamber. Methyl bromide is used at a dose of 32 g/m³ with an exposure period of 4 hours, while a longer exposure period of 5 days is allowed under atmospheric pressure in the case of aluminium phosphide at an application rate of 3 g/m³. Soon after fumigation, the seed lots are air washed for safe handling.

After fumigation, the seeds are examined visually, cleaned and then each sample is plated. Each sample packet is thoroughly examined under a magnifying lens and any small, shrunken, discoloured or damaged seeds are removed along with any other foreign material, such as crop debris, soil particles, etc. Only clean, dry and healthy seeds are plated for observation of pathogens.

X-ray and other examination.—Chickpea, pigeonpea and groundnut seeds are X-rayed for detection of latent infestation by insect pests, particularly *Bruchid* beetles and their developing instars. Apparently healthy seeds showing internal infestation are detained and destroyed. Hidden infestation in sorghum and pearl millet are detected by a Ashman Simon infestation detector. This mechanical device crushes the seeds as they pass over the rollers provided with ninhydrin treated paper leaving violet stams over it indicating the presence of live stages of insects.

Plating.—Each seed sample is plated according to the international standard for seed testing for observation of seed-borne diseases. Petri dishes containing the seeds are placed in an incubation room the temperature in which is maintained at 21 ± 1°C. After seven days, the seeds are meticulously examined under the microscope for the presence of pathogens. Seeds showing poor germination or infection by fungi or bacteria of quarantine importance are not exported. There is total detection of any seeds found to be even slightly infected with bacteria or fungi classified by the importing country. A proper record is maintained of all the seed samples examined and the pathogens noted on them for scrutiny by the plant quarantine authorities of the Government of India. There is a total capacity of plating 1152 seed samples at a time in the incubation room.

Elisa Test.—ICRISAT has a facility to detect peanut mottle virus (PMV) reported in India which can be transmitted by seed from 0.1 to 3.5% depending on cultivars. Enzyme Linked Immuno Sorbant Assay (ELISA) tests have been developed by the Groundnut Improvement Program and samples of groundnut seeds are subjected to these tests to ensure freedom from PMV virus before export.

Treatment.—The seeds selected by the ICRISAT quarantine staff for export are finally inspected by Government plant quarantine officials and only after their approval, are the seeds treated with insecticides and or fungicides mentioned in the import permits. Seeds are usually treated with chemical prior to export, unless the importers specifically request non-treatment. Broad-spectrum pesticides are generally used, eg., aldrin, metalaxyl, benomyl or thiram. Seeds intended for studies on resistance to pests or diseases, or for response to different strains of *Rhizobium*, or chemical analysis are exported without treatment.

*Danish Government Institute for Seed Pathology for Developing Countries, Copenhagen, Denmark,

Additional Declaration.—Special care is exercised to meet any additional declaration or requirement of the importing country while collecting or examining seeds for export. As an additional safeguard against the introduction of dangerous seedborne pests and diseases, a few countries insist on the issue of an import permit in which a statement of freedom from a specific pathogen or its non-existence in the country or area from which seeds are collected is incorporated in the phytosanitary certificate. A list of such countries and the specific declarations required in the phytosanitary certificates is given in Table 2.

On the basis of the regular examination of the crops in the field by the CPPTI and ICRISAT plant pathologists and entomologists, it has been possible for the Government plant quarantine authorities to include this additional declaration in the phytosanitary certificates.

Issue of Phytosanitary Certificates.—The phytosanitary certificate (PSC) is signed and issued by the authorised officers of the Government of India in the form prescribed by the FAO International Plant Protection Convention, 1951, and called the 'Rome Certificate'. It contains all the required information about the seed lot being substantially free from injurious diseases and pests, treatments, if any, given, and conformity with the additional declarations required by the importing country and description of the consignment, etc. The original PSC is put in an envelope affixed to the seed box.

Packaging and Despatch.—The seed samples are placed in paper packets or polythene bags, depending upon their size and quantity, and packed in corrugated cardboard boxes or padded shipping bags strong enough to withstand the journey and rough handling. The package is officially sealed by the plant quarantine staff of the Government of India and the carton is securely held by packing tapes reinforced further by filament and nylon tapes. Packing is always done in such a manner that it ensures not only the safety of seeds but also to prevent the entry or exit of any insect or pathogens during transit.

The seed packages are despatched by air freight or air mail post depending upon the weight of the consignment and the country to which it is being exported.

It takes 2 to 4 weeks, depending upon the size and condition of the seed samples, for completing all the formalities before despatch.

ICRISAT is also receiving seeds of minor millets from all sources as it has been designated as International Gene bank for collection of minor millet germplasm. There is also an arrangement for the export of seeds of minor millets, as and when required by the scientists of other countries.

During the last eight years, ICRISAT has exported valuable germplasm to 123 countries mainly in the semi-arid tropics. An impression

of the extent of dispersal of improved seeds from the mandate crops can be gained from Fig. 3. This also reflects the contribution of the plant quarantine units, both at ICRISAT and CPPTI, made to increase world food supplies.

It is gratifying to note that, so far, there has been no report of the introduction of any new pest or disease via the exchange of ICRISAT germplasm either in India, or abroad, and this proves that the present plant quarantine facility established by the Government of India, is functioning satisfactorily. This view is upheld by several plant quarantine specialists who have visited the ICRISAT facilities.

TABLE 1

Export of seed materials by ICRISAT to different countries

Year	Quantity (No. of samples)
1974—75	19 738
1975—76	51 381
1976—77	38 886
1977—78	59 577
1978—79	53 630
1979—80	48 830
1980—81	47 285
1981—82	54 065
1982—83	46 648

TABLE 2.

Countries requiring additional declaration in the phytosanitary certificate for the export of seeds

Country	Crop	Additional declaration
Brazil .	Sorghum .	Certified that there was no fungusborne disease caused by <i>Peronospora (Sclerospora) sorghi</i> (Kulk) Weston and Uppal observed in fields from where this seed material was harvested.
Malawi .	Sorghum .	1. The parent plants were inspected during active growth and found free of <i>Pseudomonas an-dropogonis</i> , maize dwarf mosaic virus, <i>Drechslera maydis</i> and <i>Periconia circinata</i> . 2. The seeds were harvested from fields free of <i>Sclerospora, macrospora</i> and <i>S. graminicola</i> . 3. <i>Urocystis agropyri</i> and <i>Ophiobolus graminis</i> are not known to occur in the country of origin. 4. The seed has been fumigated and treated with approved insecticide/fungicide.
	Pearl millet	<i>Urocystis agropyri</i> and <i>Ophiobolus graminis</i> are not known to occur in the areas where this crop is grown. The seed is treated with approved insecticide/fungicide and fumigated before despatch.

Fig. 3 Distribution pattern of seeds and plant materials ICRISAT manda's crops.

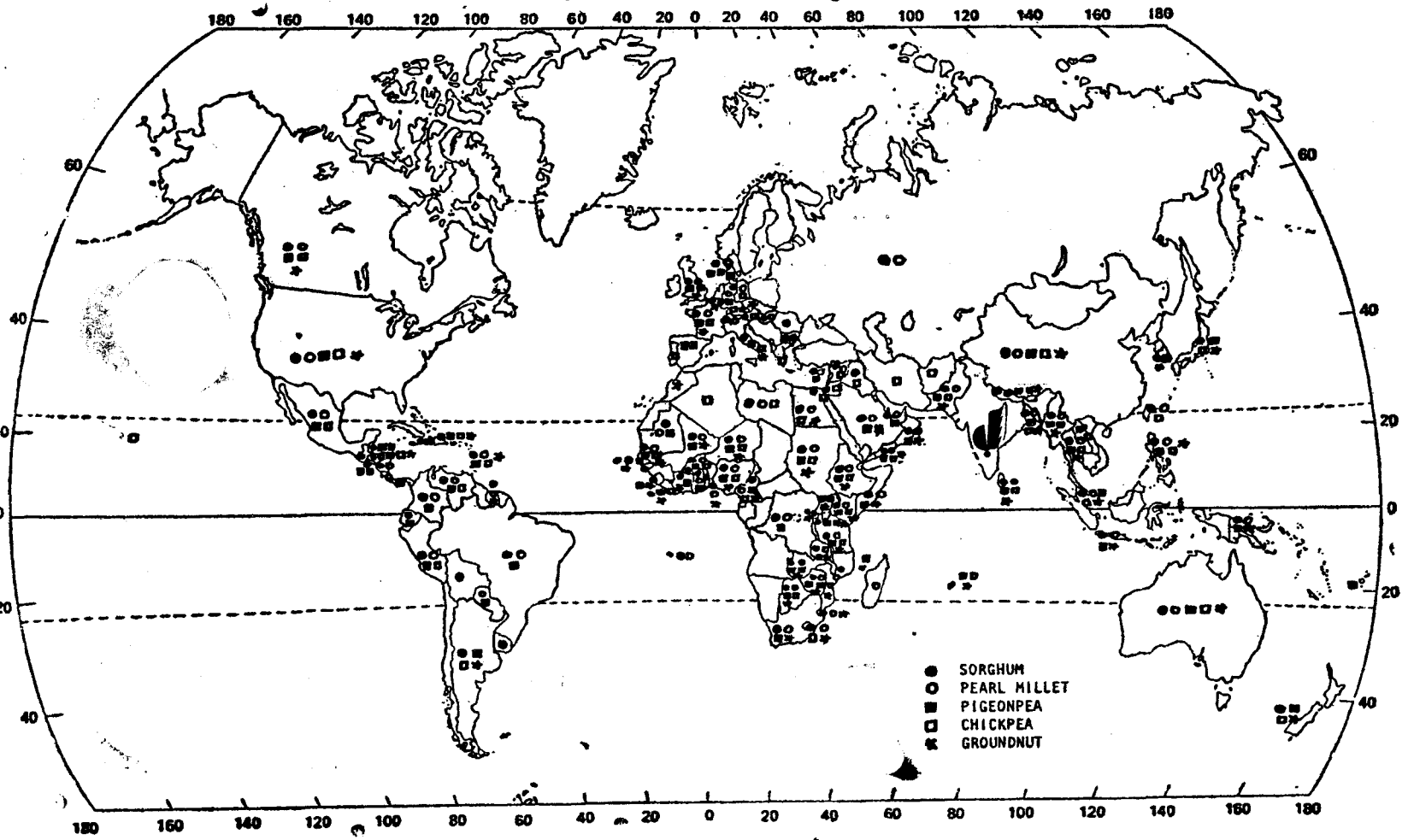


TABLE 2—Contd.

Country	Crop	Additional declaration	Country	Crop	Additional declaration
	Chickpea	1. Bacterial blight (<i>Pseudomonas pisi</i>) is not known to occur in country or state of origin. 2. The mother plants were inspected and found free of alfalfa mosaic virus, pea mosaic virus and tomato spotted wilt virus. 3. Seed is dressed with fungicide and insecticide.			<i>sacchari</i> and <i>Xanthomonas stewartii</i> . 2. The sorghum crop was inspected regularly during its active growth period at its source of origin and was found free of downy mildews (<i>Sclerospora macrospora</i> , <i>S. philippinensis</i> and <i>S. sacchari</i>).
	Pigeonpea.	1. Bacterial blight (<i>Pseudomonas pisi</i>) is not known to occur in country or state of origin. 2. The mother plants were inspected and found free of alfalfa mosaic virus, pea mosaic virus and tomato spotted wilt virus.		Pearl millet	1. Pearl millet seeds were free from downy mildews <i>Sclerospora sacchari</i> , <i>St. philippinensis</i> and <i>Sclerophthora macrospora</i> and these pathogens are not known to occur on millets in India. 2. The pearl millet crop was inspected regularly during its active growth period of its source of origin and was found free of smuts (<i>Ustilago</i> spp.), blast (<i>Pyricularia setariae</i>), and bacterial streak (<i>Xanthomonas panici</i>).
	Groundnut	1. The parent plants were inspected in active growth and found free from bacterial and virus diseases. 2. The consignment is free from <i>Caryedon serratus</i> (<i>C. gonagra</i>) and <i>Trogoderma granarium</i> (Khapra beetle). 3. The seeds are treated with approved fungicide and insecticide before despatch.		Groundnut	The seeds are free from collar rot (<i>Diplodia gossypina</i>) and stunt, mottle, ring spot, bunchy top, chlorosis and ring mottle viruses.
Mauritius	Chickpea .	The parent plants were inspected during active growth and found free from <i>Ascochyta</i> (<i>Mycosphaerella</i>) <i>rabiei</i> or that <i>Ascochyta rabiei</i> does not occur in the area of production.	Republic of China (Taiwan).	Sorghum .	The sorghum species are free from gumming disease (<i>Xanthomonas vasculorum</i> (Cobb) (Dows) and originates from areas free from <i>X. vasculorum</i> .
	Groundnut	Parent plants were inspected during active growth and found free from the following : (i) Groundnut mottle virus, (ii) Groundnut rosette virus, (iii) marginal chlorosis virus, and (iv) Ring spot virus.	Republic of South Africa	Sorghum .	1. Parent plants were inspected during active growth and found free from <i>Pseudomonas andropogonis</i> , maize dwarf mosaic virus, <i>Periconia circinata</i> and <i>Drechslera maydis</i> . 2. Seed was adequately treated with an appropriate fungicide and fumigant (treatment to be specified on the phytosanitary certificate).
Nigeria .	Sorghum .	1. Sorghum seeds were harvested from fields which were inspected during active growth and found to be free from <i>Sclerospora</i>			