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Report on the Collection of Crop Germplasm in P.D.R. Yemen

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Crop Collecting in P.D.R. Yemen 1988-1989

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During 1988 and 1989 IBPGR collaborated with El-Kod Agricultural Research Centre (Director: Dr A.B. Mu'Allem), of the Department of Research & Extension (Director: Dr A.W. Mukred), Ministry of Agriculture & Agrarian Reform of P.D.R. Yemen, in collecting germplasm of field crops throughout the country. The main counterpart in the field was Mr Ahmed Al-Ghaz of the Agronomy Section. This was part of an IBPGR initiative to fill major collecting gaps for several crops in the Arabian Peninsula by strengthening national plant genetic resources programmes in the region.

Three separate collecting expeditions were carried out. From 29 Oct.-23 Nov., 1988, most of the major agricultural areas of the western and central parts of P.D.R. Yemen were visited. The period 4 Feb.-18 March 1989 (to be referred to as the 1989a mission), was mainly devoted to the island of Socotra, though one mainland agricultural area was also visited. During 16 Sept.-14 Oct. 1989 (1989b), the far east of the country was collected, as well as a high-altitude area in the west. All of the major agricultural regions have now been collected. Wild species, including crop relatives, were collected extensively on Socotra and limited areas of the mainland. These will be considered in separate reports.

The Country

P.D.R. Yemen is situated in the southeastern part of the Arabian Peninsula and is bordered by Yemen A.R. and the Kingdom of Saudi Arabia to the E and N, the Sultanate of Oman to the W and the waters of the Gulf of Aden to the S. It stretches from latitude 13 N to 19 N and from longitude 43 E to 53 E. Its area is about 338,000 sq km, less than 0.5% of which is cultivated. The population is about 2.2 million, 40% of whom are urban dwellers; of the rural population, 10% are nomadic.

The country is divided administratively into six Governorates. From W to E these are: Lahej, Aden, Abyan, Shabwa, Hadramawt and Mahra; the island of Socotra belongs to the Aden Governorate. Some figures for cultivated area and population for each Governorate are provided in Table 1.

The physiographic regions of the country may be briefly summarized. The long axis of the country (ca. 1000 km) is oriented W-E, parallel with the coast. In the W, the land rises

from a narrow coastal plain in a series of scarps and plateaux to over 2000 m (over 3000 m further N in Yemen A.R.). The plateaux widen out and decrease in height eastwards. In the centre of the country, they are dissected parallel to the coast by Wadi Hadramawt, and fall away to the basin of the Empty Quarter to the N. Further E, they continue as the Jebel Mahra and, in Oman, the various mountain ranges of Dhofar.

Agro-ecologically, it is possible to recognize five main zones See Table 2 for temperature data for sites in the different zones. Table 3 for figures for the relative importance of spate and ground-water irrigation in different regions and Table 4 for areas of different crops in each Governorate.

(1) The **coastal strip** varies in width from less than 1 km to 80km. It has a hot tropical desert climate with mean annual rainfall <100 mm. Most cultivation in this zone is based on spate irrigation and is largely confined to the deltas of large wadis in Lahej and Abyan Governorates, eg the Tuban, Abyan and Ahwar deltas, where the soils are calcareous silty to sandy loams. The main crops are cotton, sorghum, sesame, various vegetables and tropical fruits.

(2) The **Wadi Hadramawt zone** (Hadramawt Governorate) is at 400-500 m of altitude and the climate is again hot tropical desert, though somewhat more extreme in temperature and considerably drier than the coastal area. Soils are calcareous loams and gravelly sands. There is an adequate but decreasing supply of ground-water for irrigation which has been exploited for centuries. The main crops are date palm, sorghum, wheat, alfalfa and various fruits.

(3) The **mid-altitude zone** comprises plateaux (eg, Lawdar) and wadis (eg, Beihan) at about 600-1000 m (most of the agricultural areas of Shabwa Governorate are in this region, together with some in Abyan). The climate is hot sub-tropical desert. Sorghum, millet and sesame are the main crops, but wheat and Catha edulis can be grown in some areas.

(4) The **high-altitude zone** (>1500 m) of Lahej and Abyan Governorates enjoys a semi-arid monsoon tropical highland climate, with mean annual rainfall of about 250-600 mm during the period June to September. There is sometimes another, less pronounced, period of rain in October-March. Sorghum, millet, barley and wheat are grown under dry-farming on terraces on the mountain slopes and on the undulating summit plateaux, the soils being calcareous loams developed on colluvium. In valleys are also grown coffee and Catha.

(5) The **mountains of Mahra**, together with the highlands of Dhofar across the Oman border, due to a peculiar combination of monsoonal weather systems and topography, receive upwards of 1000 mm of rain and occult precipitation during the period July-September and are therefore thickly vegetated with forest and grassland, uniquely in P.D.R. Yemen and the

Arabian Peninsula in general. They are inhabitated by semi-nomadic pastoralists who keep an endemic breed of cattle and grow sorghum, cowpea and cucumbers in rain-fed enclosures.

Agriculture is central to the economy of P.D.R. Yemen. There is a large public sector. In addition to over 30 state farms directly owned and run by the Ministry of Agriculture and Agrarian Reform, there are about 75 co-operatives of different types. Some data on crop areas on state, co-operative and individually-owned farms in 1980 is provided in Table 5.

The crop collections

Fifteen or so agricultural areas may be recognized within the five agro-ecological zones of P.D.R. Yemen. These are listed in Table 6 together with when they were visited for germplasm collection. Figure 1 is a map of P.D.R. Yemen showing the location of the agricultural areas.

Some 351 collections of 30 or so crops have been made during the three missions to P.D.R. Yemen (Tables 7 & 8). Sorghum, pearl millet, wheat, cowpea, alfalfa, sesame and barley are, in order, the most collected crops, accounting together for about 80% of collections. This reflects the high priority collection of these crops has been given in the region as a whole by a variety of recent studies. These are discussed below, putting the P.D.R. Yemen collections in the context of similar recent work in the region as a whole. Figures on areas for all crops come from Central Statistical Organization (1988), Department of Economic Studies and Statistics (1988) and Directorate General of National Statistics (1984).

WHEAT AND BARLEY

The wheat- and barley-growing areas of southern Arabia

The traditional wheat- and barley-growing areas of the southern half of the Arabian Peninsula, southeast of a line from Jiddah to the Straits of Hormuz, are for the most part confined to the mountains of the eastern and southern corners. The former, the limestone chain of the Hajar, are in the northern part of the Sultanate of Oman. The latter, which in contrast are made up of Precambrian crystalline rocks, stretch northwards from western P.D.R. Yemen, through Yemen A.R. to Makkah in the Kingdom of Saudi Arabia. This is the "Arabia Felix" of antiquity.

The eastern mountains. In northern Oman, wheat is for the most part grown under irrigation in oases in the southern foothills of the Western Hajar (the Dhahirah and Al Joof Regions) and to a

much lesser extent in the northern foothills, in the lee of the Eastern Hajar and under rainfed conditions in the Musandam peninsula and on terraces above 1500 m on Jebel Akhdar, the highest peak of the W. Hajar.

The total area of wheat in Oman is perhaps 300 ha. The crop is sown in November-December and harvested in March-April. Rain falling on the mountains, which can amount to 300 mm annually at the highest elevations, is brought to the oases of both the gentle northern slopes and the steep seeward slopes and foothills from springs and localized concentrations of groundwater by ancient systems of tunnels and surface conduits known as "Aflaj". Mean annual temperature in the wheat-growing areas varies from 27 C at 500 m in the Al Joof to 17 C at 1700 m on J. Akhdar.

Barley is a minor crop in Oman, not usually used for human consumption except in the Musandam peninsula in the far north. There and at the higher elevations of the Western Hajar mountains, barley, like wheat, may in favourable years be grown rainfed during the winter, harvesting being usually in mid-March. Elsewhere the crop is irrigated. On the Batinah plain, between the Hajar mountains and the Gulf of Oman, barley is exclusively grown in mixture with alfalfa: when it is wanted to establish a new stand of alfalfa, barley may be sown at the same time, to be cut green for fodder once or twice along with the alfalfa. There are no figures for the total area of barley in Oman, but barley is certainly not as important a crop.

The southern mountains. In the southern corner of Arabia, wheat is grown under dryland conditions in terraces above 1500 m and under irrigation in the mid-altitude (600-1200 m) areas on the inland side of the mountains. The dryland region stretches from the northern part of the Abyan and Lahej governorates in P.D.R. Yemen (the Mukeiras, Dhala and Yafa'a areas), through the central highlands of Yemen A.R. (the provinces of Taiz, Ibb, Al Beidah, Dhamar, Sana'a and Sa'adah), to the Abha (Aseer), Al Bahah and Taif regions of southwestern Saudi Arabia. In this large area stretching over 1000 km from north to south and perhaps 100 km wide on average, wheat is sown from November to January over some 65000 ha; harvesting is from March to July, depending on latitude and altitude. Mean annual rainfall exceeds 300 mm throughout the higher elevation area and increases from north to south, where it can reach 1000 mm. The seasonal pattern also changes, shifting from the winter to the summer. In Yemen A.R., a summer wheat sowing is possible. Mean annual temperature is about 18 C at 2200 m, with occasional winter frosts.

The irrigated, mid-altitude region includes Wadi Hadramawt in P.D.R. Yemen (6000 ha of wheat) and the belt of oases stretching from Nisab and Beihan in the Shabwa governorate of P.D.R. Yemen, through Marib in Yemen A.R., to Najran and further north in Saudi Arabia (up to 10000 ha of wheat). Mean annual rainfall is <100 mm throughout. Mean annual temperature is 23 C at Najran (1200 m), and frosts are unknown.

The rainfed terraces of the mountains of the southern corner of Arabia are where most of the barley grown in the region is to be found. Of perhaps 80-90000 ha of barley in this area, 15-25% are in Saudi Arabia and 75-85% in Yemen A.R., where rainfall is generally higher than further north and more evenly spread through the year. The high-altitude barley area of P.D.R. Yemen is probably less than 500 ha.

About half the barley area of the region is in the 300-400 mm zone and most of the rest in the 400-500 mm zone (Ceccarelli & Mekni, 1985). In the southern uplands of Yemen A.R., the crop may be sown throughout the year. In the northern uplands of Yemen A.R. and in Saudi Arabia there are winter and summer sowings. Mean annual temperature is about 18 C at 2200 m, with occasional winter frosts. Barley is used for human consumption throughout the area, and also as a livestock feed occasionally in Saudi Arabia. The practice of sowing with alfalfa, as in Oman, has been observed in the Aseer mountains of Saudi Arabia.

Barley is also grown to a very limited extent under irrigation in the mid-altitude (1000-1200 m) oasis belt in the lee of the southern mountains, for example at Beihan in the Shabwa governorate of P.D.R. Yemen and at Najran in Saudi Arabia. The total area probably does not much exceed 200 ha.

Wheat germplasm collections in southern Arabia

When in 1985 Chapman produced a survey of wheat genetic resources, the only Arabian Peninsula country which could be said to be even marginally covered was Yemen A.R. Chapman recorded 143 wheat accessions from there, largely the result of cooperation between the national genetic resources programme and GTZ (1978-9) and IBPGR (two missions in 1980, reported by Ayad & Croston (1980) and Sackville Hamilton (1981)). He also recorded 50 accessions from P.D.R. Yemen, which in fact were never duplicated and have been lost. Wood (1980), reporting on the GTZ mission, recommended for future collecting the southern upland areas and eastern desert fringes of Yemen A.R. and, in other countries, the Aseer mountains of Saudi Arabia, the Hadramawt region of P.D.R. Yemen and the mountains of Oman.

The remaining areas in Yemen A.R. were to varying extents covered by the subsequent missions organized by IBPGR in 1980, though the eastern area remains under-collected, but Chapman was still obliged in 1985 to list the mountainous regions of Saudi Arabia, P.D.R. Yemen and Oman as Priority 1 areas for wheat collection worldwide, the main areas so described left in southwest Asia. He made the recommendation largely on the basis of the under-representation (or non-representation) of these areas in national and international collections, but clearly the comparatively rapid development which has been characteristic of much of the region in the last fifteen years, and the concomitant threat of accelerated genetic erosion, would have been an added reason for early collection in these countries. As we shall see, the

evidence for significant genetic erosion in the past decade is strong.

All the areas listed as high priorities for wheat collecting have now been covered by collaborative missions between the relevant national plant genetic resources programmes and IBPGR. In 1987, Oman was collected in conjunction with the Department of Research of the Ministry of Agriculture and Fisheries (Guarino, 1988). In 1988, a mission took place in P.D.R. Yemen with the support of the Department of Research and Extension of the Ministry of Agriculture and Agrarian Reform (Guarino and Al-Ghaz, 1989). In 1989, it was the turn of Saudi Arabia and the National Agriculture and Water Research Centre of the Ministry of Agriculture and Water (Guarino and Al-Juwaied, 1989). A further mission took place the same year in P.D.R. Yemen. In all cases, other crops were also collected, in particular barley, sorghum, millet and alfalfa, with regard to all of which, as much as for wheat, the region is under-represented in world collections as much as in national collections.

Table 9 shows the number of wheat accessions now available in the international germplasm network from the four countries dealt with here. Note that the 1989 mission in Saudi Arabia was confined to the mountainous southwest of the country, and that probably none of the 28 other accessions available from Saudi Arabia were collected in this region (14 of these are in the USDA collection, and were collected up to forty years ago, certainly not from the Aseer). Other regions of Saudi Arabia remain to be systematically collected. Figure 2 shows the geographic distribution of wheat collections made by missions involving national genetic resources programmes in southern Arabia and IBPGR. Table 10 breaks down the totals from Table 9 into numbers of accessions of Bread wheat, Durum wheat and T. dicoccon. For an idea of variation within each of these taxonomic units, we may consider local names for varieties.

The local varieties of wheat grown in southern Arabia

Four main local varieties are recognized in Oman: Hamira, Kule, Musane and Saraya. All are Bread wheats. Some other names have also been collected (Ghreda, Mufsegha, Byaza, Ualidi and Shallot), but it is not clear to what extent they are synonyms. Kule is by far the most widely grown variety. Hamira is found almost exclusively in the Dhahirah. In Musandam, only Musane was found. At high altitudes on J. Akhdar, where wheat may be grown rainfed, only Saraya was collected. Triticum dicoccon was also grown in the past, under the name Alas, but only in a few places and, apparently, not recently.

The following wheat varieties have been collected in SW Saudi Arabia:

Najran: Arabi, Musane, Samra, Zrai
Abha: Ghiad, Humta, Samra, Seeb

Al Bahah: Asseria, Humta, Kobbari, Kolari, Samra, Seeb
Taif: Hamis, Makhlea

All these are Durum wheats, except Humta (and possibly Musane) which is a Bread wheat. Ghiad, Humta, Samra and Seeb are the most common types in the mountains, Samra being particularly widely grown. Kobbari is probably synonymous with Ghiad, Kolari with Seeb.

Some five types of Durum wheat are grown in Yemen A.R. T. dicoccon is also grown, under the same name as in Oman, Alas. Only one Bread wheat variety has been collected, called Masri, and it was only found at one site by the first 1980 mission. The distribution of types by provinces according to that mission was as follows:

Al Beidah: Balaidi, Hargadi
Taiz: Balaidi
Ibb: Alas, Balaidi, Baadani, Bouni, Wisni
Dhamar: Alas, Balaidi, Masri
Sana'a: Balaidi, Bouni
Sa'adah: Balaidi

In addition, a variety called Samra (cf Saudi Arabia and P.D.R. Yemen) has also been recorded, but not apparently collected, at least under that name. Note that Balaidi simply means 'local' in Arabic, and that there may therefore be considerable differences between samples so described in widely separated areas.

The following varieties have been recorded in P.D.R. Yemen (see Table 11 for collections):

Wadi Hadramawt: Amturka, Aswad-alghashmour, Ba-fatim, Bagareifa, Halba, Halba-assout, Hali, Hargadi, Masidegan, Sho'ail, Radfan
Shabwa: Halba, Musane
Abyan (Mukeiras): Arbi, Hargadi
Lahej (Yafa'a): Arbi, Hargadi, Samra

All these are hexaploid. Note that a variety called Musane has been recorded from similar sites at Beihan in P.D.R. Yemen and Najran in Saudi Arabia, but also in Oman some 2000 km away across the Rub al Khali. Hargadi seems to be a name used in the SE corner of the highland region, northern Abyan being contiguous with the Yemen A.R. province of Al Beidah, but it may be associated with a Durum type in Yemen A.R. and with a Bread type at Mukeiras in P.D.R. Yemen, though this requires confirmation, emphasizing the difficulty of relying on local names. Varieties called Alas and Sorabi are said to have been grown in Yafa'a in the past, but could not be found in 1989.

Keeping in mind the problems associated with the approach, it seems safe to suggest that perhaps some twenty main Bread wheat types are grown in southern Arabia, mainly under irrigation, and some ten main tetraploid types (including Durum types and T.

dicoccon), mainly under rainfed conditions. Comparative experimental studies are obviously needed to quantify variability within and between types.

Genetic erosion of wheat in southern Arabia

A drastic decline in the area sown to wheat in the Dhahirah region of Oman from the mid-1970's has been documented. This has been mainly due to increasing competition from Australian grain imported for processing at the Oman Flour Mill. An additional pressure on the local varieties has come from the release of Maxipak in the early 1970's and Sannine in the early 1980's. Two ICARDA varieties were released in 1985. No seed of improved varieties was made available to Omani farmers through extension centres until 1980, when some 4 t were distributed; in 1983, the figure was 11 t and the trend is still certainly upwards. Local varieties, in Oman as elsewhere, are preferred for their taste, but they are low-yielding, susceptible to lodging and for the most part lack rust and smut resistance. Probably more than 50% of wheat grown in Oman (on an area basis) is local varieties.

The situation is somewhat different in Saudi Arabia, which thanks to government policy is self-sufficient in wheat. In 1986-7, however, commercial wheat-growing projects of the sort which have helped bring this about amounted to less than 100 ha in the Aseer administrative region, compared to over 7000 ha of wheat on traditional farms, which represents a marked decline from the 1982-3 figure of almost 20000 ha. Unlike in other areas of Saudi Arabia, then, where the threat to local landraces comes from commercial agricultural projects and the influx of modern HYV's, in the Aseer the problem is one of gradual abandonment of subsistence agriculture as a way of life, in favour of cash crops or urban living. Improved varieties are grown by traditional farmers, but on a very limited scale. Local varieties are preferred, though the state flour mills will accept grain of only a small number of modern varieties.

Genetic erosion of wheat in Yemen A.R. is also occurring mainly through the abandonment of land and the increased growing of cash crops such as Catha edulis. The spread of HYV's (Sonalika was introduced in the 1970's and several other varieties since) is also significant, but perhaps of less importance. The main reasons given for the abandonment of traditional agriculture are much the same throughout the region: high cost of labour, difficulty of mechanization on steeply terraced land, greater profitability of other work, easier access due to expanding road system. A clear example of genetic erosion in Yemen A.R. is T. dicoccon (Alas), which is favoured for bread making, but needs more preparation and more favourable growing conditions than other wheats and is no longer sown anything as extensively as formerly, a situation which also obtains in Oman.

In the Wadi Hadramawt area of P.D.R. Yemen, 65% of the wheat area is now sown to HYV's, mainly Kalyansona, though Ahgaf has

recently been released. However, these cannot be grown where groundwater is more saline. Another factor protecting the local varieties is that wheat straw is almost as important economically as the grain, as it is needed in brick-making. Local varieties are thus relatively safe because of their salt tolerance and tallness. In Shabwa, Sonalika was released in 1973, and seems to have made bigger inroads than Kalyansona in W. Hadramawt. Wheat cultivation seems to have declined markedly in the high-altitude areas of P.D.R. Yemen, due to the ready availability and comparatively low price of imported grain. It was difficult in 1989 to find seed of local varieties: five were said to be common up to ten years ago but now only one (Hargadi) seems to be used, though seed of another two was eventually obtained.

Overall, it seems safe to suggest that the area sown to local varieties in the region is more than half of the total wheat area. Inevitably, this will decrease both proportionally and in absolute terms. There will be loss of genetic diversity as rarer types fall out of cultivation entirely and as fewer individual farmers' stocks of the commoner types are sown, subtly different genetically after perhaps generations of divergent selection. Some areas are more at risk than others, however, as the situation in W. Hadramawt shows. Even in the Riyadh region of Saudi Arabia, where commercial wheat farming is predominant, some farmers still grow small fields of local varieties for home consumption. These examples show clearly how important local varieties and landraces still are, and emphasize the necessity of building any national wheat breeding programme firmly on the strong foundation that they can provide. The last few years of IBPGR-sponsored systematic collecting in southern Arabia has helped to provide the material with which that foundation is being built.

Barley germplasm collections in southern Arabia

A recent IBPGR-commissioned assessment of the status of germplasm collection of ICARDA mandate crops in the ICARDA mandate countries (Toll, 1984) showed clearly how under-represented the countries of the Arabian Peninsula are in international and national barley germplasm collections: no accessions at all were recorded from Oman, P.D.R. Yemen and Saudi Arabia. As was the case for wheat at that time, Yemen A.R. was the only country in the region which was reasonably adequately covered, thanks to the three missions involving the national genetic resources programme and GTZ or IBPGR.

Toll (1984) listed the mountainous areas of the Arabian Peninsula as Priority 1 regions for wheat collecting and Priority 2 regions for barley collecting, after some areas of North Africa. Since then, these areas have been covered by collaborative missions between the relevant national genetic resources programmes and IBPGR, and both wheat and barley have been extensively collected to fill the obvious gaps that existed (see above under wheat for details).

Table 12 shows the number of barley accessions now available in the international germplasm network from the four countries dealt with here. Note that the 1989 mission to Saudi Arabia covered only the southwestern mountains: the other countries have been covered in their entirety. Other regions of Saudi Arabia remain to be collected. Figure 3 shows the geographic distribution of barley collections made by missions involving national genetic resources programmes and IBPGR.

Variability of barley in southern Arabia

Though some work on variability within national collections has been done (eg., Damania, Jackson & Porceddu, 1985), no comparative characterization or preliminary evaluation studies have as yet been carried out employing barley germplasm from throughout the region. However, as was the case for wheat in the previous paper on collecting in southern Arabia, the number of traditionally-recognized local varieties in different areas can give a limited, preliminary indication of variability within the crop.

In Oman, barley is usually simply called "Shayir", the standard Arabic word for the crop. Only two of over one hundred farmers visited in 1987 recognized and grew distinct local varieties to which they referred using different names. At Dariz in the Dhahirah region, Magdula and Nassasi are grown, and were collected, in addition to "standard" Shayir. At Al-Juwaeif in the Jau region, the varieties El-Alia and Jasima were collected. All barley grown in Oman is 6-rowed.

Ayad & Croston (1980) record collecting five distinctly named 2-rowed hulled types in Yemen A.R. (Aswad, Balaidi, Bokur, Safeh and Saglah) and one 2-rowed naked type (Habeeb, grown in the Yarim area only). They also record that a 6-row type is apparently grown in the Rada area, but could not be found. It should be pointed out that "Balaidi" may simply mean "local" or "of this place" and may be used to refer to very different things in different places. No local names for barley varieties were recorded in P.D.R. Yemen by the 1988 mission, but Mu'allem (1988) lists four local 2-row varieties: Bokur, Bothinah, Khatrin and Marboua'a.

Discussion with local farmers in the mountainous southwest of Saudi Arabia suggest that two main types of barley are recognized there, both 2-rowed, Bokur and Ghiad. They are distinguished morphologically mainly on the basis of grain size, but there are also agronomic differences, only the small-seeded type (Ghiad) being grown in summer in the area.

It is probably safe to suggest that up to about ten main morphological types of barley, most of them 2-rowed, are grown in the mountains of the southwestern corner of the Arabian Peninsula. The name Bokur is recorded from throughout this area,

Peninsula. The name Bokur is recorded from throughout this area, but experimental work is needed to determine whether samples labelled with this name, or for that matter labelled Balaidi, in fact represent single main morphological and agronomic types, and whether forms given different names in different areas also do. Even in cases where this is so, there will doubtless be considerable cryptic genetic variation between samples of the same name, and its quantification will also need experimental studies. It is to be hoped that now that a reasonably comprehensive collection from the whole region has begun to be assembled, these will soon follow.

Genetic erosion of barley in southern Arabia

It was pointed out for wheat in southern Arabia that the area sown to local varieties is decreasing both in absolute terms, as farmers leave the land or turn to cash crops, and as a proportion of the total wheat area, as development in agriculture leads to the influx of HYV's. Though all this probably also holds true for barley to some extent in some areas, the trend is not nearly so marked and the threat of genetic erosion therefore not nearly so acute at the moment.

Some idea of this may be gained by looking at when barley HYV's were first released, keeping in mind that the first introductions of wheat HYV's in the region go back to the early 1970's. No modern varieties have been released in Oman as yet. In P.D.R. Yemen, Bonus and Nabawi were introduced for their good brewing qualities, but they have not been widely adopted. Arafat and Beecher were released in Yemen A.R. in 1986, the first such introductions. In Saudi Arabia, commercial barley projects, growing cultivars like Gusto, started in the mid-1980's: they are concentrated in the northern part of the country, which has not been an important barley-growing area traditionally.

No doubt, this situation will soon change. However, we may be reasonably certain that recent barley collections in southern Arabia, in contrast to the case of wheat, have sampled variability that has not much decreased in perhaps the past few decades. It is interesting to note in this connection that though Wood (1980) suggested that naked barley was no longer grown in Yemen A.R., this was subsequently found and collected by Ayad & Croston (1980).

SORGHUM AND MILLETS

The sorghum- and millets-growing areas of southern Arabia

(1) The Tihama coastal plain and mid-altitude western foothills. The Red Sea coastal plain from Jiddah in the north to Bab al Mandeb in the south is a tropical semi-arid to arid region with

to the west in the adjacent foothills of the mountains of the southwestern corner of the Arabian Peninsula. Annual rainfall in the coastal plain is usually under 200 mm, mainly confined to the summer. Three quarters of the cultivated land is under spate irrigation, the rest under well irrigation. Rainfall increases to about 400 mm at 1000 m in the foothills. Sorghum is the main crop in the zone, its total area being probably about 250,000 ha. Grown in both winter and summer, it is cut up to four times for fodder and then left to set seed. Total millet area may be about 20,000 ha.

(2) The mountains of the southwest. This high-altitude (>1500 m) region stretches for 1000 km from northwestern P.D.R. Yemen, through the central highlands of Yemen A.R. to the Aseer mountains of southwestern Saudi Arabia and northwards to Taif. The Tihama is to the west and the desert plains of the interior to the east. Mean annual temperature is about 18 C at 2200 m, with occasional frosts, and annual rainfall 300-1000 mm. Sorghum is grown in summer in wadis and rainfed terraces, up to about 3000 m. The total area sown to the crop in this zone is probably about 700,000 ha, not much less than half the cultivable land, but in some regions, eg. the Southern Uplands of Yemen A.R., the proportion can reach 75%. It is a multi-purpose crop, being used for food and drink, fodder, building and as an energy source. Pearl millet has been collected from wadis and terraces up to about 2000 m. The total millet-growing area is probably somewhat under 100,000 ha, the bulk of it in Yemen A.R.

(3) The mid-altitude inland region of the southwest. Within the 600-1200 m region to the east of the crest of the southwestern mountains, the main sorghum growing areas are the Lodar plateau of the Abyan governorate of P.D.R. Yemen (about 2000 ha), the Radfan and Wadi Yahar (lower Yafa'a) areas of Lahej, the belt of oases stretching north of Beihan into Yemen A.R. and Saudi Arabia (about 1000 ha) and the Wadi Hadramawt region of P.D.R. Yemen (about 2000 ha). Pearl millet is grown opportunistically in all these areas except Wadi Hadramawt after rain. Mean annual temperature is 21-23 C and annual rainfall generally <200 mm. Sorghum is grown mainly in the summer; in W. Hadramawt it is sown relatively early, in March, so that it can be harvested in good time before the land is needed for wheat.

(4) The Arabian Sea coastal plains. South of the high ground of the southwestern corner of the peninsula sorghum is grown on a large scale in the Lahej, Abyan and Ahwar deltas in P.D.R. Yemen, amounting to perhaps some 10,000 ha, mainly under spate irrigation. Pearl millet is grown on perhaps half that area. It is often grown in mixture with cowpeas or mung beans. It is also found further east, in the Mukalla area and elsewhere, on a much smaller scale.

(5) The Dhofar mountains of southern Oman and adjacent mountains of Mahra in P.D.R. Yemen. A very small amount of sorghum is grown on the Salalah coastal plain in southern Oman (<100 ha), where mean annual temperature is somewhat lower (26 C) than

elsewhere along the Arabian Sea coast due to the influence of the southwest monsoon in summer. The crop used to be widely grown under rainfed conditions in the mountains immediately behind the coastal strip, which can receive the equivalent of 1000 mm in occult precipitation during the monsoon season and stretch for some 250 km, straddling the border.

(6) The Batinah coastal plain and foothills of the Hajar mountains. Sorghum and millet are grown under irrigated conditions between 0-1000 m in northern Oman, on the Batinah coastal plain and the foothills of the limestone mountains of the northeastern corner of the Arabian Peninsula. Mean annual temperature is 27-29 C. Total sorghum area is under 200 ha and toal millet area under 500 ha. Collections of sorghum have also been made at 1500 m on Jebel Akhdar, the highest point of the Hajar.

Finger millet is grown in coastal areas and mid-altitude areas up to about 1000 m in northern and southern Oman, in the Mukalla area, in Wadi Hadramawt and in the eastern and western foothills of the southwestern mountains. It is also the only cereal recently grown on the island of Socotra (P.D.R. Yemen). The crop is sown opportunistically there after floods and the plants uprooted after a month, separated into individual tillers and replanted, to be harvested for grain after a further two months; the flour is eaten with milk as a porridge.

Foxtail millet has been collected in the mountains of northern Oman and of the southwest of the peninsula. Teff was apparently grown in the Yemen highlands in the past, but has only so far been found in the region in the Maifa Hajr area of the Hadramawt governorate of P.D.R. Yemen, near Mukalla, grown on the coast and also some way inland along Wadi Hajr.

Sorghum germplasm collections in southern Arabia

Acheapong et al. (1984) review the history of sorghum and millet germplasm collection since the pioneering efforts of the Rockefeller Foundation in collaboration with the Indian Agricultural Research Programme in the 1960's. Since 1974, IBPGR and the International Crops Research Institure for the Semi-arid Tropics (ICRISAT), which has a world mandate for sorghum and millet germplasm, have been partners in filling the gaps left in the world collections of these crops. A joint Committee was set up and it met in 1981 to review the progress made up to then. Various areas within the Arabian Peninsula have featured as priorities for collecting ever since the time of the Rockefeller Committee, and the IBPGR/ICRISAT Committee again listed the Yemens, along with China and some parts of India, as the main Asian priorities for sorghum collecting. At that time, ICRISAT held 1 accession from Saudi Arabia, 1 from P.D.R. Yemen and 27 from Yemen A.R. (Mengesha et al., 1982).

Yemen A.R. was covered by the three already-mentioned collecting

missions between 1979-80. As was pointed out in the section on wheat, this was eventually followed-up by collaborative missions in 1987, 1988 and 1989 involving IBPGR and the national plant genetic resources programmes of, respectively, the Sultanate of Oman, P.D.R. Yemen and the Kingdom of Saudi Arabia. In 1989 there were also two further missions to P.D.R. Yemen, the first of which mainly concentrated on the island of Socotra but during which some mainland collections were also made (Guarino, Miller & Obadi, 1989) and the second of which was specifically aimed at sorghum in the Mahra governorate in the far east and in the high-altitude Yafa'a region of the northwest.

Table 13 shows the number of collections of sorghum made in the four countries dealt with here. Note that the 1989 mission to Saudi Arabia covered only the southwestern area, whereas the other countries were covered fully.

Figure 4 shows the geographic distribution of collections made by missions involving national genetic resources programmes and IBPGR. It can clearly be seen that all the agro-ecological zones described above have to some extent been sampled. The one area that is perhaps somewhat under-represented is the northern part of the Tihama, but it remains to be seen whether further collecting there on any but an opportunistic basis is warranted.

The varieties of sorghum in southern Arabia

Within the region, sorghum is at its most variable in the southwest corner. In Oman, only a couple of different types are recognized. In contrast, Ayad & Croston (1980) collected samples of some 27 distinctly named varieties in Yemen A.R., in addition to material collected referred to simply as Beida (White) and Hamra (Red), and which may actually (though not necessarily) include types quite different in characters other than seed colour. The area of Ibb is said to be one of particularly high variation. The varieties divide roughly into coastal, mid-altitude (800-1500 m) and high-altitude (>1500 m) types as follows:

Coastal: Beini

Mid-altitude: Adahi, Ghorba, Goura'a, Gurrah, Hagna, Haik, Kubar, Marsala, Manzala Beida, Manzala Hamra, Safra, Shab, Soumbulla, Somi, Sneisla, Tholathi

High-altitude: Bada'a, Beida Koufia'a, Bshari, Gasharshi, Nameem, Obli, Ronasi, Sherehi, Sofara, Sofara Kabir.

Some of these names also occur in Mu'Allem's (1981) enumeration of 24 varieties grown in P.D.R. Yemen, most of which have been collected (see Table 14). The names in common are shown underlined in the following list, which also includes 5 varieties

from Hadramawt governorate (Barut, Buri, Musn, Resi and Thegil), four from Yafa'a (Gaidi, Gedhar, Karti and Misra) and one from Mahra (Bateim) samples of which were collected in 1988-89 but which are not mentioned by Mu'Allem (1981) :

Coastal: Bateim, Beini, Bukr, Resi, Saif

Mid-altitude (Lodar): Ghorba, Haimar Abiad, Haimar Ahmer, Sneisla Beida, Sneisla Hamra, Za'ar

Mid-altitude (Dhala): Dhurra, Erab, Somi

Mid-altitude (W. Hadramawt): Abu-Ali, Ba-Hamar, Ba-Obeid, Ba-Quair, Barut, Buri, Ghoneimy, Musn, Rabab, Rabat, Thegil

High-altitude: Dhurra, Gaidi, Gedhar, Ghorba, Karti, Kori, Manzala, Misra, Obli, Timy

Beini seems to be the commonest type on the coasts of the Red and Arabian Seas. Sneisla is dominant in the Lodar area and seems to reach into the middle altitudes of Yemen A.R. as well. Ghorba seems to be a common type at middle to high altitudes in both countries. Another common mid- to high-altitude variety, simply known as Dhurra at Mukeiras in P.D.R. Yemen, which is the generic Arabic name for sorghum, but as Gaidi in Yafa'a, is a very distinct type with very compact heads, often reflexed, and large, cream-coloured grains; it may correspond with the variety known as Safra (Yellow) in Yemen A.R.

Wadi Hadramawt shows no names in common with other regions of P.D.R. Yemen, let alone Yemen A.R. Despite the number of different names, variation here seems to be limited to perhaps three or four somewhat similar main types, but these are likely to be to quite distinct from varieties grown elsewhere in the region. The sorghum landraces grown in the mountains of the Hauf region of Mahra in P.D.R. Yemen and in the adjacent Dhofar mountains of southern Oman are also probably quite distinct from all other south Arabian types, the area being quite isolated and agro-ecologically unique.

Mu'Allem (1981) reports that when grown together in the coastal area, coastal varieties have the shortest maturation period (100-110 days) and high-altitude varieties the longest (160-180 days), with the mid-altitude varieties intermediate. It is interesting in this context that the variety Musn collected in W. Hadramawt is locally regarded as having a 70 day maturation period there. High-altitude varieties are generally taller than coastal varieties when grown on the coast. Three classes of ear-type and six classes of grain colour are represented in the P.D.R. Yemen material.

In southwestern Saudi Arabia, five varieties are generally recognized. Azeidia (or Maribi) and Za'ar are grown on the Tihama; the former seems to be similar to Beini, the latter is a

name that has been recorded from the Lodar area of P.D.R. Yemen and the descriptions match. In the mountains are grown Beida, Hajiri (or Bjeda) and Shoka, the last of which may be similar to the Dhurra/Safra type of further south.

In summary, despite the difficulties involved in the use of local names, which are discussed in the paper on wheat, it seems nevertheless safe to suggest that there are at least 3 different main types of sorghum grown on the Tihama & other coastal areas of the southwestern corner of the Arabian Peninsula. At higher altitudes, there are probably more than 20 main types, concentrated in the southern part of the mountains. A more precise analysis must await the characterization and preliminary evaluation of the collection of material from the region as a whole. As we have seen, this now numbers some five hundred or so accessions and covers all the main agro-ecological zones, making it probably reasonably representative and complete. Only experimental work can suggest whether the few areas which are perhaps under-collected, which mainly means the northern part of the Tihama, should be high priorities for future systematic sampling. The danger of genetic erosion should of course also be taken into account, and this is discussed below.

Genetic erosion of sorghum in southern Arabia

Genetic erosion can occur in a crop if its cultivation is decline (due, for example, to the abandonment of agriculture in general or the adoption of cash crops) and/or if traditional cultivars are being replaced with exotic varieties. On neither count is there much evidence of genetic erosion of sorghum in northern Oman. The situation is different in the mountains of the south of the country, however.

In Dhofar, recent development in infrastructure has led to considerable changes in the life-style of the indigenous Jibbalis. Traditionally transhumant pastoralists, these people used to grow sorghum, cowpeas and cucumbers in stone enclosures in the mountains. Due to range degradation, these enclosures are now more commonly used to grow crops of grass for hay to feed the cattle. This and the greater availability of foodstuffs in the coastal towns have resulted in a general decline in agriculture in the mountains, never of course overly important compared to stock-rearing but nevertheless a part of the traditional way of life. No doubt, the variability of the sorghum grown in these mountains is now much less than formerly, and genetic erosion will certainly continue. The situation in the adjacent Mahra area of the far east of P.D.R. Yemen, which is ecologically and ethnically comparable, is similar, local people saying that they grow much less sorghum than formerly due to the ready availability of other foodstuffs. However, genetic erosion has probably not progressed as rapidly here as across the border.

Sorghum is such an important crop in the western parts of P.D.R. Yemen that it is unlikely that it will be replaced to any large

extent by other crops or by imports. The bigger threat is the influx of modern varieties. However, Mu'Allem (1981) has suggested that there is little danger of this in P.D.R. Yemen, as farmers are in general very attached to their traditional types and modern varieties which have been tested have tended not to be satisfactorily dual-purpose. This is also said to be the case in Yemen A.R. (Wood, 1980). A short ACSAD variety suitable for mechanized harvesting on large state farms has been tested in W. Hadramawt and will be released soon, but this is the only such case and is unlikely to have a great effect on genetic variability. Seed production projects may have a more significant effect. These provide 2-3 local varieties, mainly to coastal areas, and may lead to the replacement of other cultivars and farmer's landraces. Recent efforts have mainly aimed at purifying Beini, but breeding work is due to start this year. One variety, Za'ar, has, according to Mu'Allem (1981), gone out of production recently.

In the mountains of Yemen A.R. the risk of replacement of sorghum with cash crops, particularly Catha edulis, is considerable. Though it is hardly likely that over half a million hectares of sorghum will completely succumb, it is possible for it to disappear completely, along with other crops, from localized areas: Ayad & Croston (1980) give the examples of Wadi Al Lahhad near Dhamar, Wadi Al Sirr and parts of Wadi Dhar near Sana'a. This danger does not exist further north in Saudi Arabia, but the Aseer mountains may be more vulnerable to the generalized effects of development on traditional agriculture.

Wadis on the Tihama are being developed both in Yemen A.R. and in Saudi Arabia, with the introduction of improved varieties. The effects of this as so far probably fairly localized, but they are bound to increase and spread, perhaps particularly in Saudi Arabia. It seem fair to suggest that this is the one area within southern Arabia where systematic collecting of sorghum, as of pearl millet, remains a fairly high priority, combining as it does a relatively high risk of genetic erosion with under-representation in the collections made thus far.

Millet germplasm collections in southern Arabia

Acheapong et al. (1984) reviewed the status of millet genetic resources world-wide up to 1982, bringing somewhat up to date information on the ICRISAT collections provided by Mengesha et al. (1982). The Arabian Peninsula was not seen as a particularly high collecting priority for pearl millet, but several countries of the same priority status were much more heavily collected in 1975-82 than the only country in our region that was sampled, that is Yemen A.R. The three collecting missions between 1979-80, involving the national genetic resources programme of Yemen A.R. and GTZ or IBPGR collected some 70 accessions of pearl millet, apparently the only representation from the Arabian Peninsula up to that time. No collections of the other species were recorded at all.

The follow-up IBPGR missions mentioned above under sorghum also collected millets widely. Table 15 shows the number of collections of the four millet species discussed now available in the international germplasm network from the four countries dealt with here. Note that the 1989 mission to Saudi Arabia covered only the southwestern area, in contrast to the other missions, which were country-wide. Figure 5 shows the geographic distribution of collections made by missions involving national genetic resources programmes and IBPGR.

Genetic erosion of millet in southern Arabia

There is little information on the variability within millet species grown in southern Arabia, and on the threat of genetic erosion. The less common species are likely to eventually drop out of cultivation: teff, for example, is very well established at its one site in the region, but there is evidence that it was formerly widely grown in Yemen A.R., as was finger millet. Local people on Socotra say that finger millet was formerly much more common on the island; it is now very rarely grown, and seed was only found in one village in 1988.

As for pearl millet, Ayad & Croston (1980) state that there is wide variation in Yemen A.R. and that genetic erosion is increasing with the introduction of foreign types. Distinct local varieties are not on the whole traditionally recognized by farmers, however, who generally refer to pearl millet simply as Dokhn (or Museibli in most of P.D.R. Yemen, though on the Salalah plain of southern Oman and in the adjacent Mahra region of P.D.R. Yemen this word refers to a perennial Pennisetum cut for forage) and to finger millet simply as Bambi (Oman), Kenab (Yemen) or Majdul (Saudi Arabia). Mu'Allem (1988) also believes the threat of genetic erosion of pearl millet is strong. Exotic varieties and selections have been introduced into P.D.R. Yemen since the early 1970's; the variation available within the local types was not believed to be sufficient to lead to substantial improvements in yield. Introductions have also been made in Saudi Arabia, but millet growing is still entirely confined to the traditional sector.

It seems likely that the collections of pearl millet now available are reasonably representative of the variation that has existed in the region in the recent past. Genetic erosion will probably accellerate in the future, but most of the agro-ecological areas of millet-growing in the region have been covered thoroughly enough to ensure that its effects will to some extent be buffered. The only major geographic gap in pearl millet representation is the Saudi Arabian section of the Tihama. The 1989 mission was primarily aimed at wheat, and the lowlands were therefore considerably less well covered than the higher altitude regions. Systematic collecting in the coastal area is to be recommended, particularly as development is likely to be most rapid there.

Because none of the other species is particularly important anywhere in the region, it is difficult to come to similarly clear conclusions about them. However, unless evaluation of the presently available material reveals interesting variation, further collecting should perhaps be limited to opportunistic sampling.

ALFALFA

The alfalfa growing areas of southern Arabia

Alfalfa is generally called Kathb or related names in most of southern Arabia. An alternative name, Berseem (applied to Trifolium alexandrinum in Egypt) is occasionally used, particularly in southern Oman. Alfalfa has traditionally been the main fodder crop throughout the Gulf and in the oases areas of central and western Saudi Arabia, and this is still the case. In the mid- and high-altitude areas of the southwestern corner of the peninsula its importance is less, sorghum being the main fodder crop, and it is not grown at all on the nearby Red Sea coastal plain (the Tihama) or to any large extent along the southern coast of the peninsula except around Mukalla and Salalah.

Six main agro-ecological zones of alfalfa growing may be recognized in the southern half of the Arabian Peninsula, southeast of a line from Jiddah in the west to the Straits of Hormuz (figures on areas come from Central Statistical Organization (1988), Department of Economic Studies and Statistics (1988) and Directorate General of National Statistics (1984)):

(1) The Batinah costal plain of northern Oman. This lies between the Hajar mountains to the south and the waters of the Gulf of Oman to the north. Mean annual temperature is about 29 C, with very high humidity throughout the year. Total alfalfa area rose rapidly throughout the 1970's and was over 1000 ha by the mid-1980's. The crop is sown in November-January, sometimes mixed with barley. Up to twelve cuts a year are made, amounting to a green matter yield of on average 80 t/ha/yr given irrigation of around 5500 mm/yr. Stands are said to last over ten years before requiring re-sowing.

(2) The foothills of the Hajar mountains. Alfalfa is grown in wadis and oases on both the seaward and the inland sides of the mountains of northern Oman, generally at altitudes of 300-1000 m but also at over 1500 m on Jebel Akhdar in the Western Hajar. Mean annual temperature is 27 C at 500 m and 17 C at 1700 m. Some 2000 ha are grown. Management and yields are similar to the Batinah, except that irrigation is usually over 8000 mm/yr and different varieties are grown.

(3) The Salalah coastal plain of southern Oman. This lies between the Dhofar mountains to the north and the waters of the Indian Ocean to the south. Mean annual temperature is about 26 C. During July and August the region is strongly affected by the southwest monsoon, which causes a bank of cloud to shroud the seaward faces of the mountains and the coastal plain for several weeks, generally depressing temperatures when they should be at their highest. There are about 300 ha of alfalfa on the Salalah plain. In marked contrast to northern Oman, in the south the crop is grown as an annual, succumbing to an anthracnose during the monsoon season.

(4) The Hadramawt coastal region of P.D.R. Yemen. Alfalfa is grown on a small scale in coastal settlements either side of Mukalla. Mean annual temperature is about 29 C. Total alfalfa area is probably 200 ha or so.

(5) The high mountains of the southwest. This high-altitude (>1500 m) region stretches for 1000 km from northwestern P.D.R. Yemen, through the central highlands of Yemen A.R. to the Aseer mountains of southwestern Saudi Arabia and northwards to Taif. Mean annual temperature is about 18 C at 2200 m, with occasional frosts, and annual rainfall 300-1000 mm. Some 3000 ha of alfalfa are grown in the Saudi Arabian part of the mountains, and probably the same amount in the Yemen A.R. part, though no exact figures on the latter could be found. The crop is sown in winter, usually mixed with barley, and is said to be cut up to 20 times a year given sufficient water, though 4-6 times is more usual.

(6) The mid-altitude region inland of the southwestern mountains. This includes Wadi Hadramawt in P.D.R. Yemen (600 m) and the belt of oases stretching from Beihan in P.D.R. Yemen to Najran and further north in Saudi Arabia (900-1200 m). Mean annual temperature is 21-23 C, and frosts are unknown. Total alfalfa area may be up to 1000 ha, with about half of that in W. Hadramawt. Here stand persistence is generally only 2-3 years, though whether this is due to too frequent cutting, nematodes, poor nodulation or a combination of these factors is not clear.

Alfalfa germplasm collections in southern Arabia

In 1985, the IBPGR Working Group on Forages for Mediterranean and Adjacent Semi-arid Areas, designated the Arabian Peninsula as a priority area for the collection of Medicago sativa. At that time, excluding material from Yemen A.R. collected by the two missions in 1980 involving the national genetic resources programme and IBPGR, there were no national alfalfa collections in the region and the three main world collections held less than fifty accessions from an area where probably 15,000 ha of alfalfa are cultivated (about half in the southern part of the peninsula). The South Australia Department of Agriculture held 14 accessions from Saudi Arabia, 1 from "Yemen" and "a few" from Oman; the United States Department of Agriculture GRID database

recorded 9 accessions from Saudi Arabia and 4 from Oman; and the N.I. Vavilov Institute, U.S.S.R. held 8 accessions from Yemen A.R. and 5 from P.D.R. Yemen.

In an attempt to fulfill the 1985 Working Group recommendation, as well as similar recommendations regarding other crops in the region, these were followed-up by collaborative missions in 1987, 1988 and 1989 involving IBPGR and national genetic resources programmes in the Sultanate of Oman, P.D.R. Yemen and the Kingdom of Saudi Arabia, as mentioned in the previous sections.

Table 16 shows the number of alfalfa collections now available in the international germplasm network from the four countries dealt with here. Note that the 1989 mission to Saudi Arabia covered only the southwestern mountains, in contrast to the other missions, which were country-wide. Other regions of Saudi Arabia remain to be collected, but these lie mainly outside the area under consideration here. Figure 6 shows the geographic distribution of collections made by missions involving national genetic resources programmes and IBPGR.

Clearly, though the situation is considerably better than it was when the 1985 recommendation was made, more collecting may be necessary. Though all the main ecological zones of alfalfa growing in southern Arabia have now been sampled to at least some extent, the high mountain region of the southwest, including Yemen A.R. and the Aseer mountains of Saudi Arabia, remains relatively under-collected. Oman and P.D.R. Yemen have probably been adequately covered. Whether further collecting in Zone 5 is needed is discussed below with reference to what is known of variability within the crop in the region.

The alfalfa varieties of southern Arabia

In view of the fact that in southern Arabia alfalfa is at its most important in the Gulf areas, it is not surprising that it seems to be most variable in northern Oman. Four different varieties are traditionally recognized there, and were collected in 1987, a "mountain" type grown throughout the Hajar foothills and three "coastal" types, grown respectively on the Batinah, at Qurayat and at Sur. In addition, the alfalfa grown on the Salalah plain in southern Oman is quite distinct, and was also collected. Yet another different form was apparently widely grown in the Musandam peninsula of Oman until recently; though one sample of this was collected, most of the alfalfa currently grown in the area is of the Batinah type, which seems to perform adequately. This seems to be an exception, however, as the basis on which farmers make these distinctions is more agronomic than morphological: traditional knowledge has it that attempts to grow a mountain type on the coast, or any northern type in the south, will not be successful, and this is largely supported by the limited experimental work.

In other areas in the region, no differences are recognized

within the alfalfa crop. This is the case in W. Hadramawt and in the Aseer mountains of southwestern Saudi Arabia. It is the W. Hadramawt type that is apparently grown along the coastal plain around Mukalla, though some genetic differentiation might be expected. The type of alfalfa grown in the Aseer is called locally Shawbi to differentiate it from types grown further north in the Medina area (Hejazi) and in the central and eastern regions (eg., Qassimi and Hasawi). Generally, no such differences are recognized in Yemen A.R., though at one site in Dhamar province Ayad & Croston (1980) record collecting two samples which local farmers treated as distinct from the "standard" type, and referred to as Kouli and Rimani. GTZ (1976) differentiates in the northern uplands of Yemen A.R. only between a rainfed type called Agar and an irrigated type called Gheil.

Perhaps further collecting in Zone 5, narrowly targeted on alfalfa, will reveal more traditionally recognized varieties. However, Rumbaugh et al. (1988), working on a large Moroccan alfalfa collection, concluded that accessions could be confidently assigned to five "ecotypes" defined solely in terms of the geographic regions from which they were collected, and that pooling their 146 accessions into 3-5 such populations was a valid tool in selecting for quantitatively inherited adaptive traits. As was pointed out earlier, on the simplistic basis of number of samples collected, the area may be under-represented, but if the Moroccan work applies here and a generalized high altitude southwest Arabian population may be recognized, and if variability within the area is anyway as low as traditional lore seems to imply, intensive follow-up collecting might not be necessary. It should also be pointed out, however, that there has been a report of Yemeni material being phenotypically somewhat isolated among North African and Midlle Eastern types (Smith et al., in press). In any case, further alfalfa collecting in Zone 5 should perhaps await the characterization and evaluation of the material so far assembled.

Genetic erosion of alfalfa in southern Arabia

So far, genetic erosion of alfalfa in southern Arabia as a result both of the generalized replacement of the crop and the replacement of local varieties with introduced ones has not been great. It is, however, bound to increase. Thus, if the recent introduction of Rhodes grass and other fodder crops in Oman and Saudi Arabia and the increasing use of feed concentrates have not yet significantly affected the importance of alfalfa, it is only a matter of time until they do. Alfalfa area has already decreased somewhat in the 1980's in the Aseer, though it has been increasing in other areas of Saudi Arabia, both in the commercial and the traditional sectors, and in northern Oman.

Trials have been conducted in most of the countries employing introduced modern cultivars of the crop, but the widespread use of these seems to be restricted to Saudi Arabia. Even here, commercial alfalfa projects are confined to the central, eastern

and northern regions, and alfalfa growing in the west and southwest is still largely traditional, employing local germplasm. This is probably largely because the variety trials that have been done have been aimed at identifying suitable material for conditions in the central and eastern areas only. No doubt modern varieties which can outperform the locally adapted strains in the southwestern mountains exist and will be introduced in due course. One clear case of complete replacement of a local alfalfa in southern Arabia is that of the Musandam type mentioned above. Overall, however, this is not yet become a problem.

OTHER CROPS

Sesame. Ashri (1989) reports on the IBPGR-funded assembling of a Sesamum world collection, in response to the recommendations of two FAO Expert Consultations (in 1981 and 1985) and the 1985 IDRC Oil Crops Network Workshop. Arabian Peninsula countries are poorly represented, but collections made in the last couple of years have as yet not been included. Table 17 shows the number of collections of sesame made in the four countries dealt with here. Note that the 1989 mission to Saudi Arabia covered only the southwestern area, whereas the other countries were covered fully.

Figure 7 shows the geographic distribution of collections made by missions involving national genetic resources programmes and IBPGR. Sesame is a very well-established crop in the coastal areas of the southwestern corner of the Arabian Peninsula, and variability is probably highest here, though there is as yet no data on this. Sesame-seed oil is expensive but very well-liked, so its replacement with imported substitutes is perhaps not as rapid as might be expected on a solely economic basis. Throughout the region, only varieties with brown to black seeds are grown, but samples of light-coloured seeds, said to have been imported from Ethiopia, have been collected in the Abyan delta of P.D.R. Yemen.

In general, however, oil is extracted from locally-produced seed. The crop is thus unlikely to be under severe threat of genetic erosion in most of the region, though it may perhaps eventually drop out of cultivation in isolated areas, for example in Oman. The northern part of the Tihama is probably the most serious gap in the collection, but little is known of sesame variation in the region and it is unclear whether further collecting here should be a priority. Such a decision must await characterization and evaluation of the collections made thus far.

Grain legumes. As with most of the other crops dealt with in this series of papers, the Arabian Peninsula is not well represented in world germplasm collections of grain legumes. ICARDA has a worldwide mandate for the improvement of lentil and faba bean and

worldwide mandate for the improvement of lentil and faba bean and shares the mandate for chickpea with ICRISAT. It has assembled large germplasm collections of these crops, but, as far as the region under consideration is concerned, recent germplasm catalogues record only 37 lentil accessions from Yemen A.R. (Erskine & Whitcombe, 1984), 5 faba bean pure line accessions from the same country (Robertson & El-Sherbeeny, 1988) and no kabuli chickpea accessions at all (Singh, Malhotra & Witcombe, 1983). Singh & Rachie (1985) list 20 accessions in the IITA cowpea world germplasm collection as being from "Yemen", probably Yemen A.R.

Table 18 shows the number of collections of grain legumes made in the four countries dealt with here. Note that the 1989 mission to Saudi Arabia covered only the southwestern area, whereas the other countries were covered fully.

Figure 8 shows the geographic distribution of collections made by missions involving national genetic resources programmes and IBPGR. Lentil has only been collected in the region at altitudes of 2000 m and over in the southwestern mountains. Faba bean and pea have basically a similar distribution, but have also been collected at lower altitudes (c. 500 m) in northern Oman. Chickpea has been collected only in Oman, at altitudes of 300-500 m. The very few pigeonpea collections are from altitudes of less than 500 m, whereas lablab and fenugreek have been collected in the range 500-2000 m. Cowpea has the most extensive distribution, having been collected in all agro-ecological zones and from sea level to over 2000 m.

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	Areas					
	1975		1986		Pop.	
	Well	Spate	Well	Spate	1975	1986
Aden	1118	0	507	0	306	407
Lahej	5119	14814	17541	21368	288	382
Abyan	7652	37432	12746	28978	328	434
Shabwa	5763	5291	5138	4694	171	226
Hadramawt	21165	6416	22084	5917	517	686
Mahra	0	0	970	65	64	85

Table 1. Cultivated areas (acres) of state and co-operative farms and population (thousands) by Governorate, 1975 and 1986 (Central Statistical Organization, 1988).

	Zone	Altitude (m)	Mean max.	Mean min.
Aden	1	0	31.9	26.1
Riyan	1	0	30.9	28.8
Seiyun	2	500	35.7	20.2
Beihan	3	900	33.1	16.5
Dhala	4	1400	29.1	14.6
Mukeiras	4	2000	22.1	9.1

Table 2. Temperatures at selected sites in different agro-ecological zones of P.D.R. Yemen.

	Spate	Well
Abyan delta	62,500	10,000
Lahej delta	20,000	7,500
Wadi Hadramawt	15,000	15,000
Nisab-Beihan	8,250	6,750

Table 3. Cultivated areas (acres) according to method of irrigation in four agricultural areas (Report of FAO Programming Mission, 1980).

Governorate	Wheat	Maize	Sorghum	Millet	Barley	Cotton	Sesame	Fodder	Dates	Catha	Banana	Coffee
Aden	0	7	40	5	0	41	0	1771	461	0	0	0
Lahej	372	3447	25365	16400	631	2452	235	2384	55	2986	167	1516
Abyan	266	850	12272	5486	391	3148	1589	5632	6	313	1173	1568
Shabwa	1799	185	2074	2159	387	0	1201	1189	358	211	27	0
Hadramawt	7262	123	7307	888	4	1	266	2819	4598	0	284	0
Mahra	23	38	372	28	0	0	0	704	1517	0	13	0

Table 4. Areas (acres) cultivated to different crops by nominal and individual holders in each Governorate in 1986 (Central Statistical Organization, 1988).

	State	Co-ops	Individual	TOTAL
Wheat	1.1	9.2	2.5	12.8
Sorghum & millet	2.6	31.0	10.1	43.7
Maize	0.9	6.8	3.9	11.5
Barley	0.0	0.2	0.2	0.4
Fodder	7.1	11.6	5.6	24.3
Sesame	1.5	7.1	4.3	12.8
Cotton	0.3	14.5	0.0	14.8
Tobacco	0.0	0.7	0.1	0.8
Coffee	0.0	1.5	0.2	1.6
Potatoes	0.1	1.2	0.4	1.6
Tomatoes	1.4	1.8	0.4	3.5
Onions	0.2	1.2	0.4	1.7
Other vegetables	0.8	2.7	0.5	4.0
Cucurbits	1.5	1.7	0.2	3.4
Dates	0.0	6.8	4.7	11.5
Bananas	1.2	0.3	0.1	1.5
Other fruits	0.3	0.5	0.1	0.9
TOTAL	18.7	98.6	33.6	150.7

Table 5. Crop areas ('000 acres) in state, co-operative and individually-owned farms (Report of FAO Programming Mission, 1980).

	Region	Governorate	Maximum altitude	Zone	Year of collection
A	Abyan and Ahwar deltas	Abyan	100	1	1988
B	Tuban delta	Lahej	200	1	1988
C	Hadramawt coast	Hadramawt	100	1	1988
D	Wadi Hajr	Hadramawt	500	1/2	1989a
E	Wadi Hadramawt	Hadramawt	600	2	1988
F	Lawdar plain	Abyan	900	3	1988
G	Naqabah region	Shabwa	900	3	1988
H	Ataq-Nisab-Beihan	Shabwa	1200	3	1988
I	Dhala	Lahej	2000	4	1988
J	Mukeiras	Abyan	2000	4	1988
K	Yafa'a	Lahej	2100	4	1989b
L	Jebel Mahra	Mahra	1000	5	1989b
M	Mahra coast	Mahra	100	1	1989b

Table 6. Agricultural regions of P.D.R. Yemen.

	A	B	C	D	E	F	G	H	I	J	K	L	M
Abelmoschus			2										
Allium			5		1						1		
Amaranthus			1										
Brassica								1	1				
Capsicum			1										
Carthamus											1		
Coriandrum					1								
Cucurbita			1										
Dolichos					1						1		
Eleusine			1	1	1								
Eragrostis			1	1									
Gossypium								1					
Hordeum								2	1	4	2		
Lens											2		
Luffa			2										
Lycopersicon			1										
Medicago			9		6					1	1		1
Nicotiana			1										
Pennisetum millet	9	1	5	1		7	2	5	2	1	5		
P. sp. (Museibli)													6
Phaseolus										1			
Raphanus			4		1				1				
Sesamum	6		1	1	2	1	1	1					1
Setaria								1					
Sorghum	19	14	6	1	23	17	4	14	12	3	26	6	7
Trigonella					1				1				
Triticum					25			2		2	5		
Vigna radiata	6			1									
V. unguiculata	8	1		1		4		1	1	1	3	3	
Zea									1		2		

Table 8. Collections of crops by region, 1988-9.

Table 9. Collections of wheat made by collaborative missions involving national programmes of four Arabian Peninsula countries and IBPGR (1980-1989), as well as others (according to Chapman, 1985), and now available in the international germplasm network.

	1980	1980	1987	1988	1989	Other	Total
Oman			72				72
P.D.R. Yemen				29	5		34
Saudi Arabia					26	28	54
Yemen A.R.	59	9				75	143

Table 10. Numbers of collections of Bread wheat, Durum wheat and T. dicoccon from four Arabian Peninsula countries available in the international germplasm network.

	Bread	Durum	Emmer	Unknown
Oman	63	-	9	-
P.D.R. Yemen	34	-	-	-
Saudi Arabia	17	28	2	7
Yemen A.R.	1	51	13	78
TOTAL	110	79	24	85

	E	H	J	K
Amturka	2			
Aswad-alghashmour	4			
Ba-fatim	1			
Bagareifa	3			
Halba	7			
Halba-assout	3			
Hali	2			
Masidegan	2			
Radfan	1			
Arbi			1	1
Hargadi			1	3
Samra				1
Musane		2		

Table 11. Collections of wheat varieties by region, 1988-9.

Table 12. Collections of barley made by collaborative missions involving national genetic resources programmes of four Arabian Peninsula countries and IBPGR in 1980 (2 missions), 1987, 1988 and 1989, as well as others, and now available in the international germplasm network.

	1980	1980	1987	1988	1989	Other	Total
Oman			51				51
P.D.R. Yemen				7	2		7
Saudi Arabia					13	5	18
Yemen A.R.	77	12				56	145

Table 13. Collections of sorghum made by collaborative missions involving national genetic resources programmes of four Arabian Peninsula countries and IBPGR in 1980 (2 missions), 1987, 1988 and 1989 (3 missions), as well as others available at ICRISAT or reported by Wood (1980).

	1980	1980	1987	1988	1989	Other	Total
Oman			56				56
P.D.R. Yemen				113	40	1	154
Saudi Arabia					21	1	22
Yemen A.R.	128	77				151	356

	A	B	C	D	E	F	G	H	I	J	K	L	M
Beini	11	1	1	1			1						
Ghorba		6					2						
Resi			4										
Saif		7						5			1		
Zaar	5												
Abu Ali					3								
Ba-Quair					2								
Barut					2								
Buri					3								
Musn					1								
Rabab					1								
Thegil					1								
Haimar						1							
Senaisela						15			1		1		
Erab									3				
Somi									2				
Dhurra						1	1	9	6	3			
Bateim													2
Erba													1
Gaidi											4		
Garaba											11		
Gedhar											1		
Karti											1		
Misra											2		
Obli											2		
Unknown	3		1		10						3	6	2

Table 14. Collections of sorghum varieties by region, 1988-9.

Table 15. Collections of (a) pearl millet, (b) finger millet, (c) foxtail millet and (d) teff made by collaborative missions involving national genetic resources programmes of four Arabian Peninsula countries and IBPGR in 1980 (2 missions), 1987, 1988 and 1989 (2 missions), as well as others, and now available in the international germplasm network.

(a)

	1980	1980	1987	1988	1989	Other	Total
Oman			8				8
P.D.R. Yemen				33	6		39
Saudi Arabia					2		2
Yemen A.R.	19	19				32	70

(b)

	1980	1980	1987	1988	1989	Other	Total
Oman			7				7
P.D.R. Yemen				2	2		4
Saudi Arabia					1		1
Yemen A.R.							0

(c)

	1980	1980	1987	1988	1989	Other	Total
Oman			4				4
P.D.R. Yemen				1			1
Saudi Arabia					1		1
Yemen A.R.							0

(d)

	1980	1980	1987	1988	1989	Other	Total
Oman							0
P.D.R. Yemen				1	1		2
Saudi Arabia							0
Yemen A.R.							0

Table 16. Collections of alfalfa made by collaborative missions involving national genetic resources programmes of four Arabian Peninsula countries and IBPGR in 1980 (2 missions), 1987, 1988 and 1989 (2 missions), as well as others, and now available in the international germplasm network.

	1980	1980	1987	1988	1989	Other	Total
Oman			83			4+	87+
P.D.R. Yemen				16	7	5	28
Saudi Arabia					4	23	27
Yemen A.R.	6	5				8	19

Table 17. Collections of sesame made by collaborative missions involving national genetic resources programmes of four Arabian Peninsula countries and IBPGR in 1980 (2 missions), 1987, 1988 and 1989 (3 missions), as well as others reported by Wood (1980).

	1980	1980	1987	1988	1989	Other	Total
Oman			6				6
P.D.R. Yemen				13	2		14
Saudi Arabia					2		2
Yemen A.R.	5	3				12	20

Table 18. Collections of grain legumes made by collaborative missions involving national genetic resources programmes of four Arabian Peninsula countries and IBPGR in 1980 (2 missions), 1987, 1988 and 1989 (3 missions).

	Vigna	Dolichos	Cajanus	Cicer	Lens	Pisum	Trigonella	Vicia
Oman	59	7	2	9	0	1	23	4
Saudi Arabia	7	0	0	0	3	0	1	0
P.D.R. Yemen	31	3	0	0	2	0	2	0
Yemen A.R.	48	0	2	0	35	19	20	23

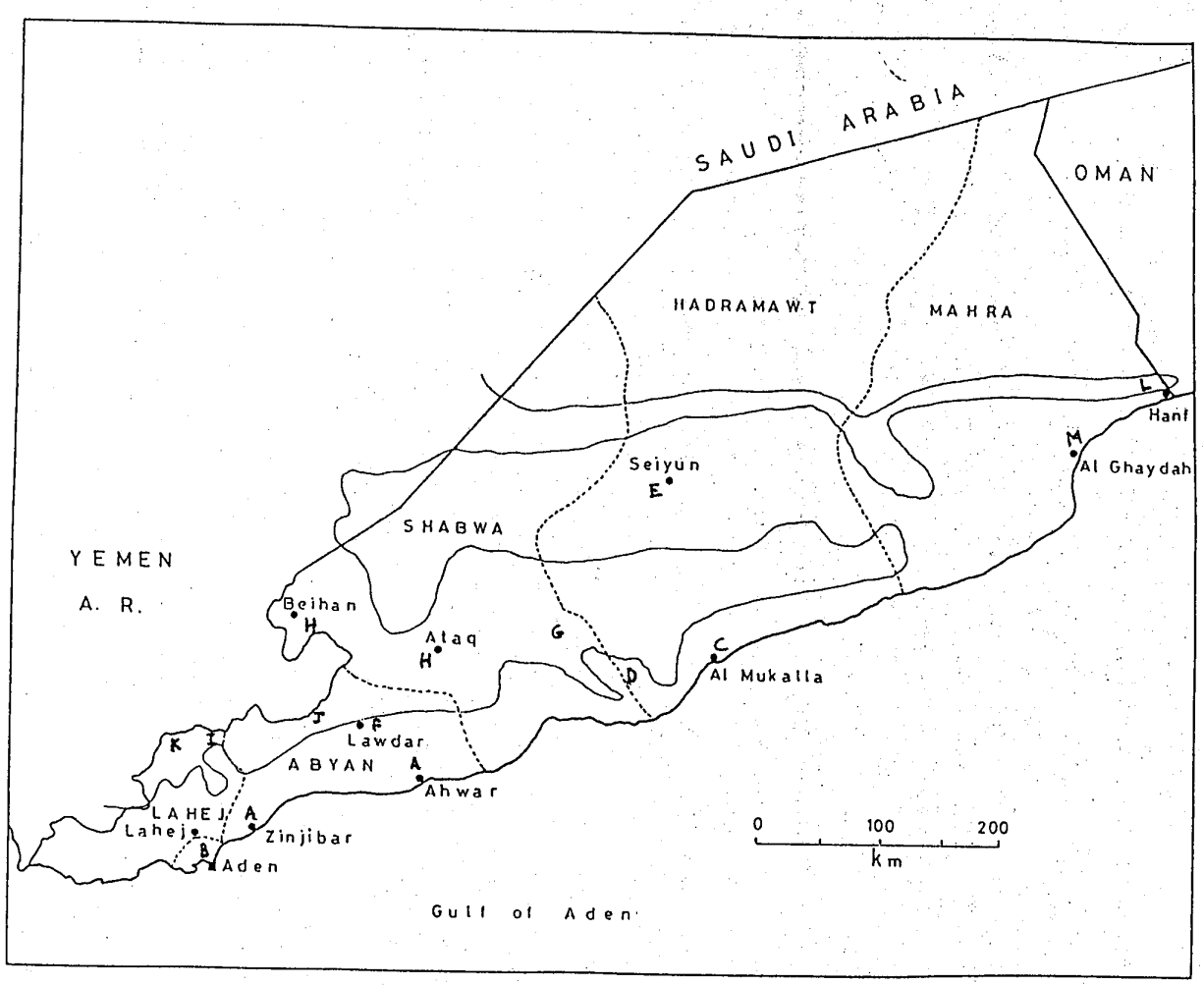


Figure 1. Map of P.D.R. Yemen showing Governorates, some major towns, agricultural regions (A-M) and the 1000-m contour.

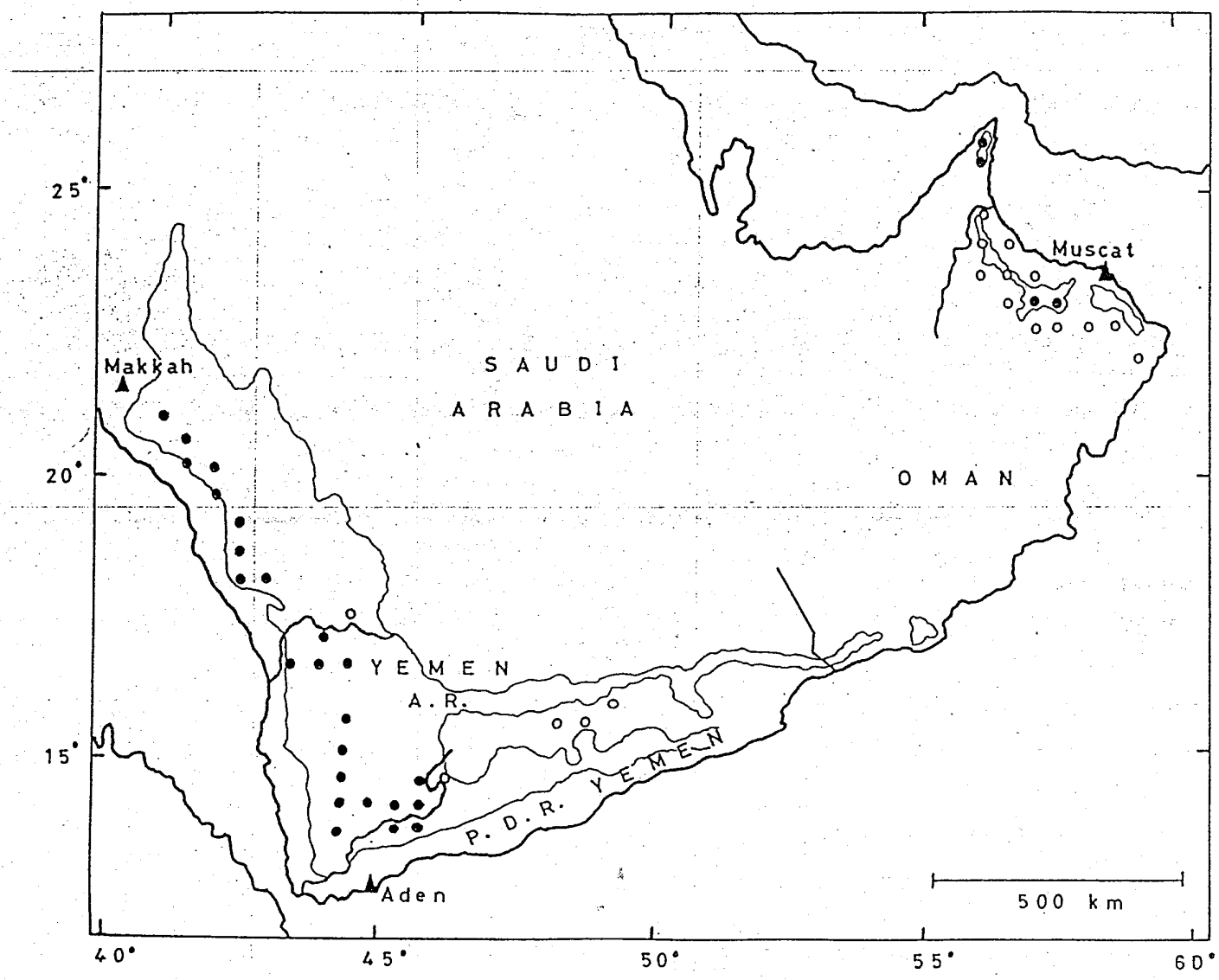


Figure 2. Map of the southern part of the Arabian Peninsula showing where wheat has been collected by collaborative missions involving national genetic resources programmes in the region and IBPGR. Circles mark those 30' latitude x 30' longitude sectors where at least one Triticum sp. collection has been made. Were the circles are filled wheat is predominantly grown under rainfed conditions. The 1000 m contour is shown.

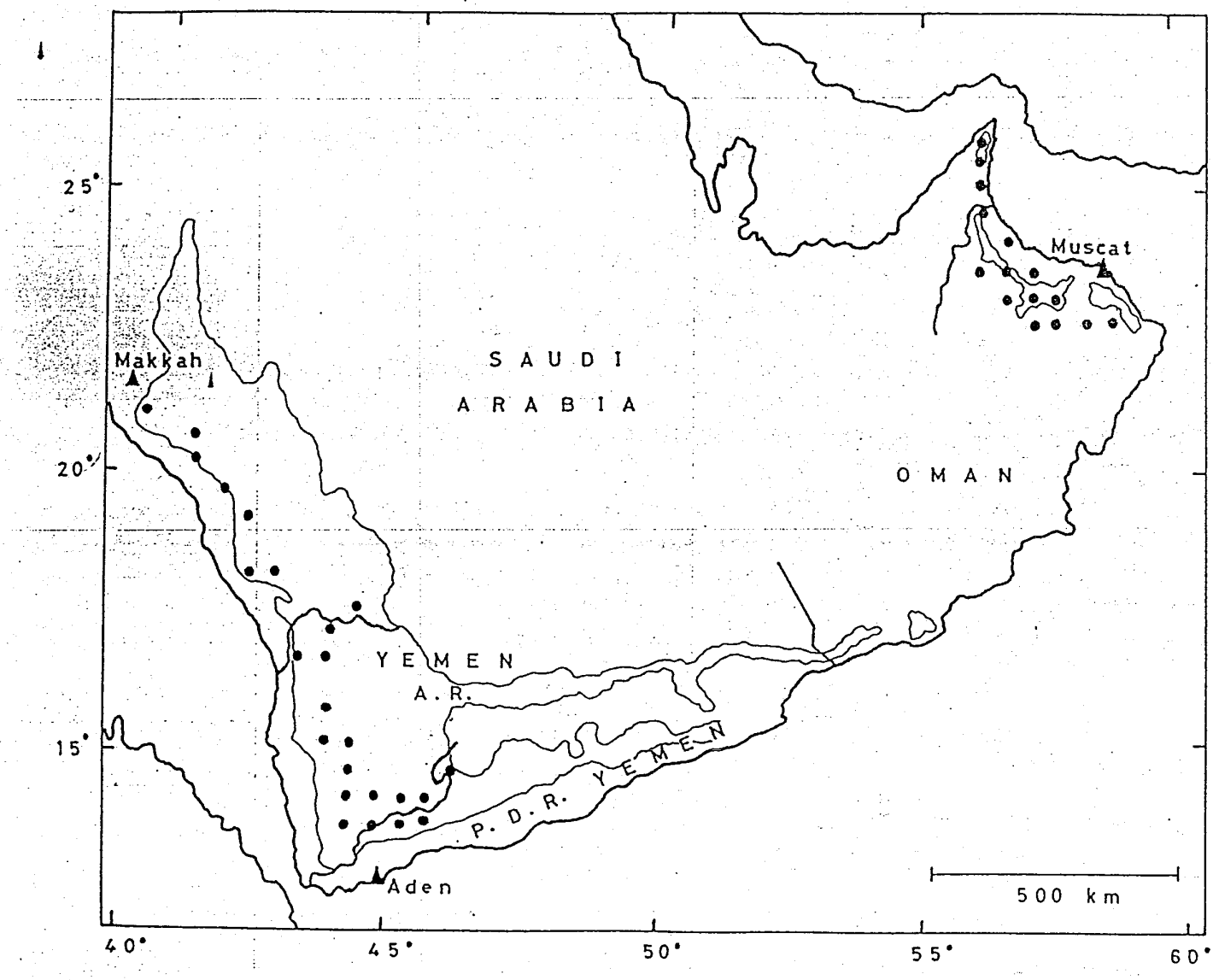


Figure 3. Map of the southern part of the Arabian Peninsula showing where barley has been collected by collaborative missions involving national genetic resources programmes in the region and IBPGR. Circles mark those 30' latitude x 30' longitude sectors where at least one Hordeum vulgare collection has been made. The 1000 m contour is shown.

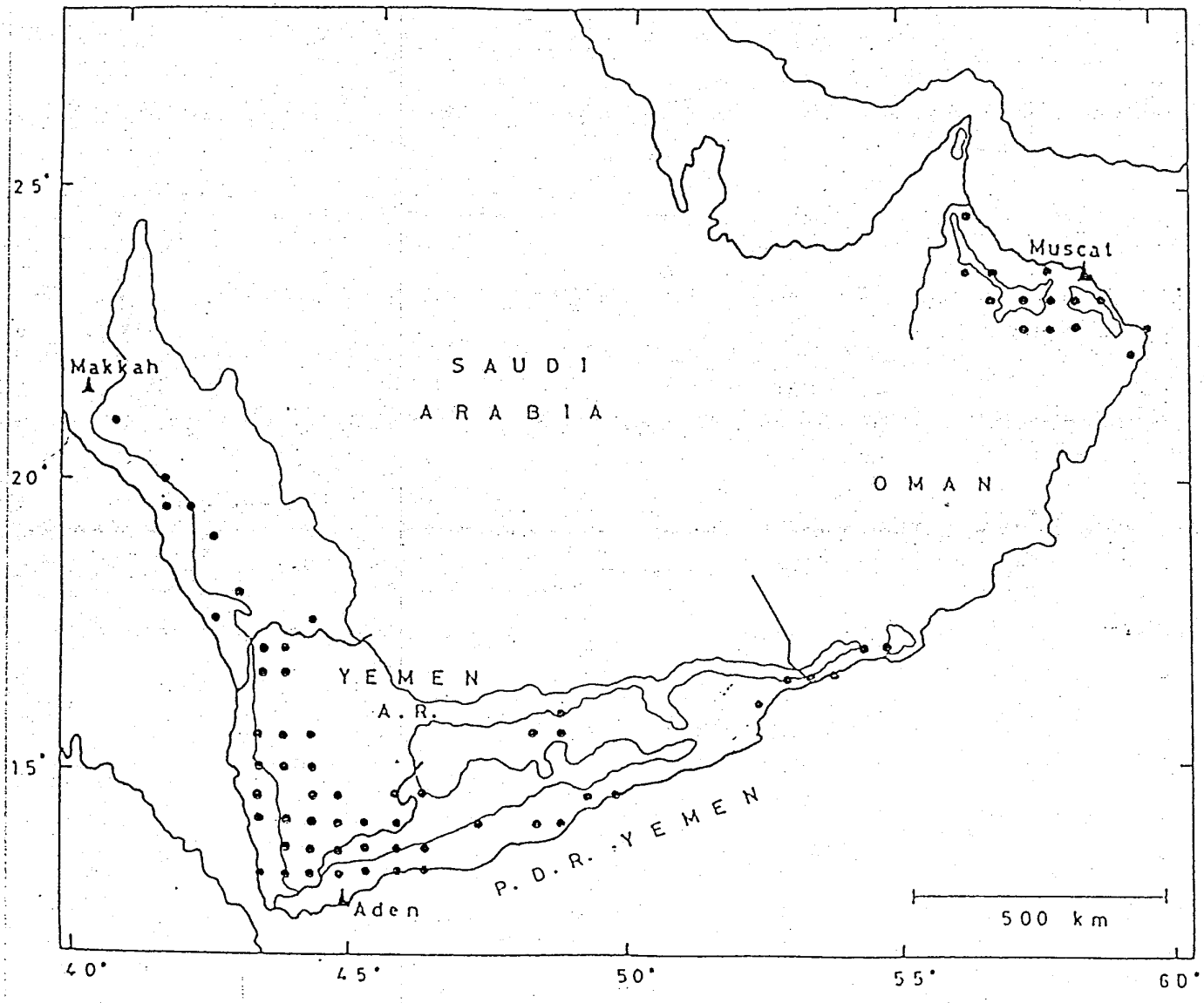


Figure 4. Map of the southern part of the Arabian Peninsula showing where sorghum has been collected by collaborative missions involving national genetic resources programmes in the region and IBPGR. Circles mark those 30' latitude x 30' longitude sectors where at least one Sorghum bicolor collection has been made. The 1000 m contour is also shown.

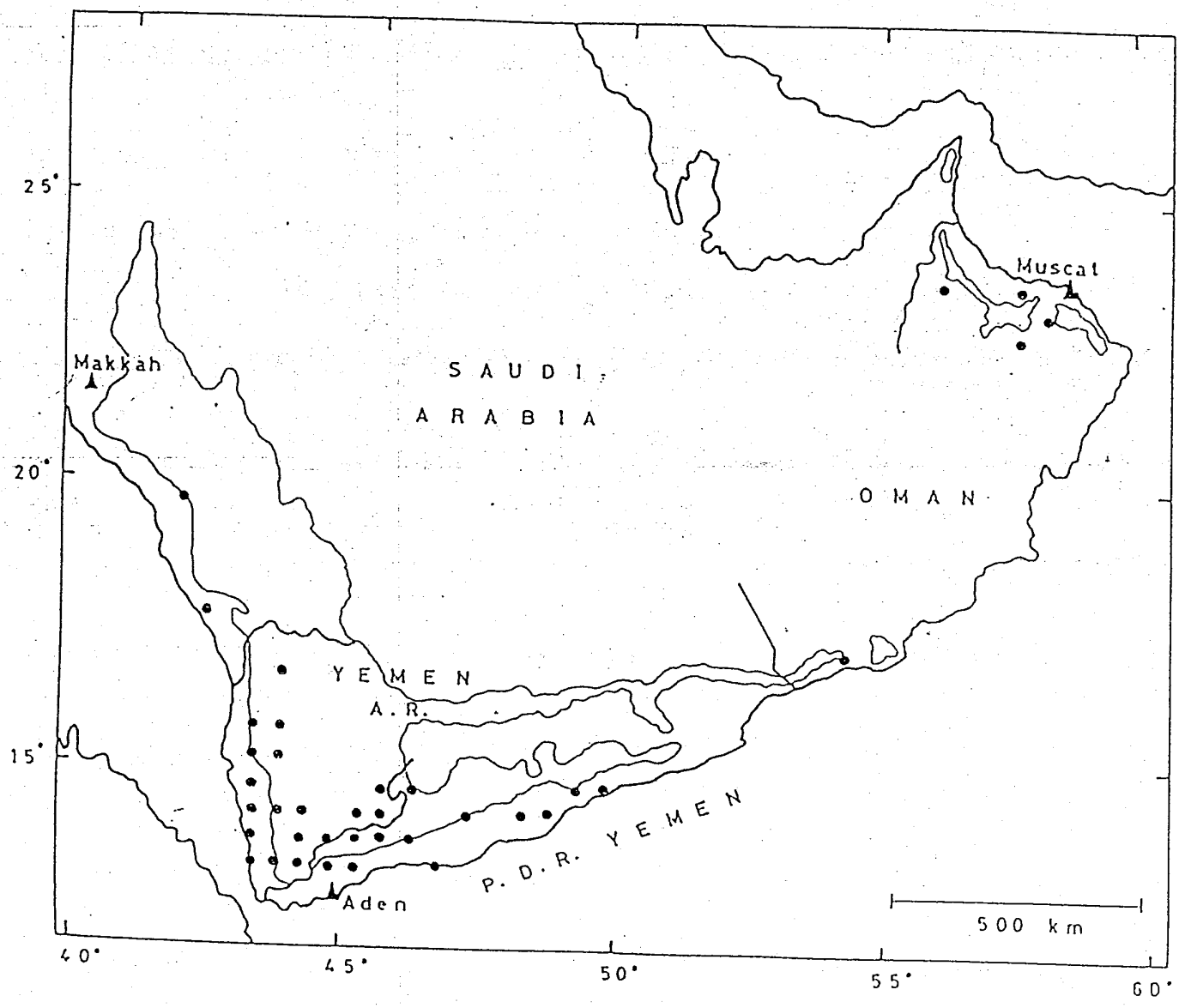


Figure 5 (a). Map of the southern part of the Arabian Peninsula showing where pearl millet has been collected by collaborative missions involving national genetic resources programmes in the region and IBPGR. Circles mark those 30' latitude x 30' longitude sectors where at least one Pennisetum glaucum collection has been made. The 1000 m contour is also shown.

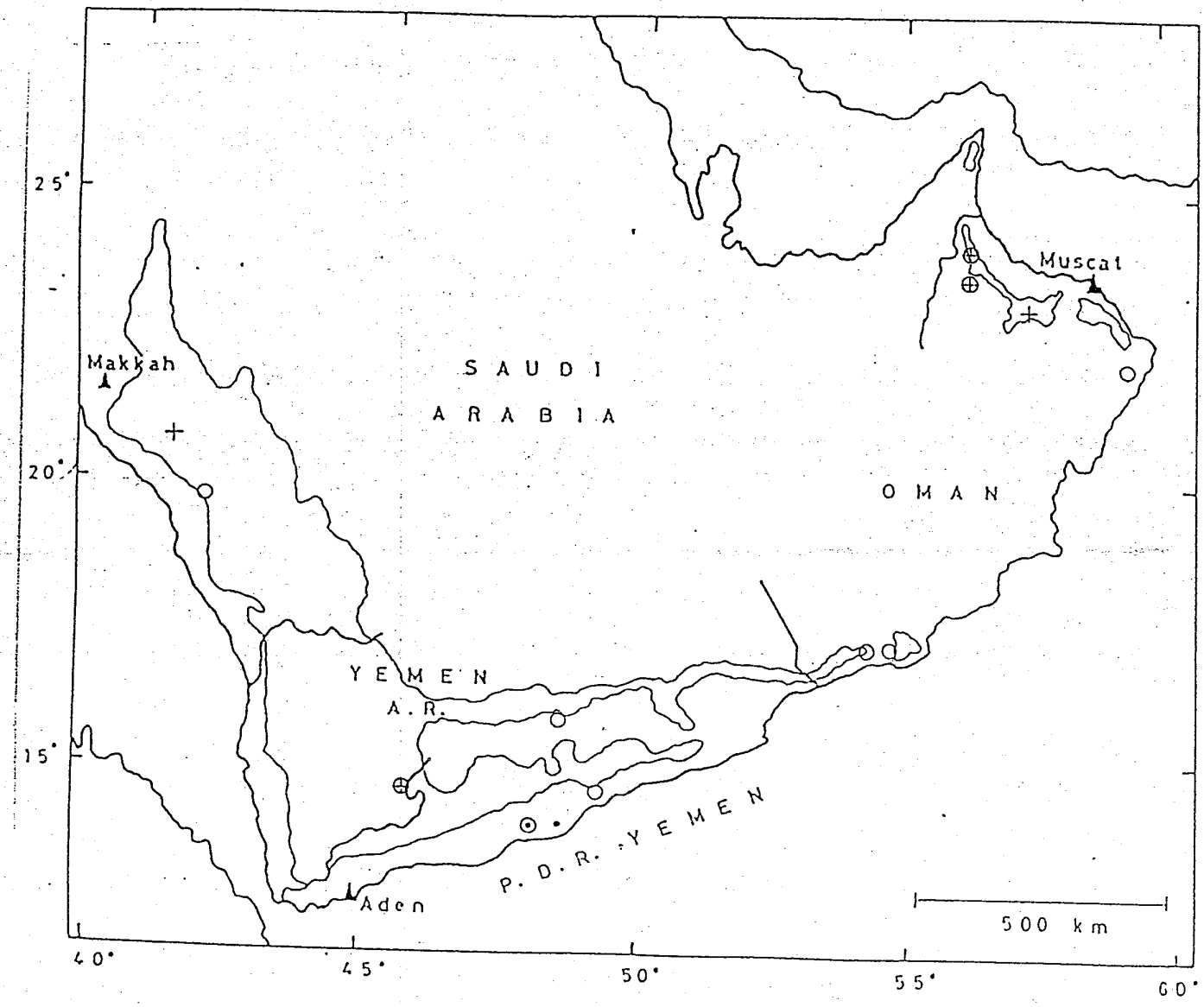


Figure 5 (b). As for Figure 5, but for Eleusine coracana (o), Setaria italica (+) and Eragrostis tef (.).

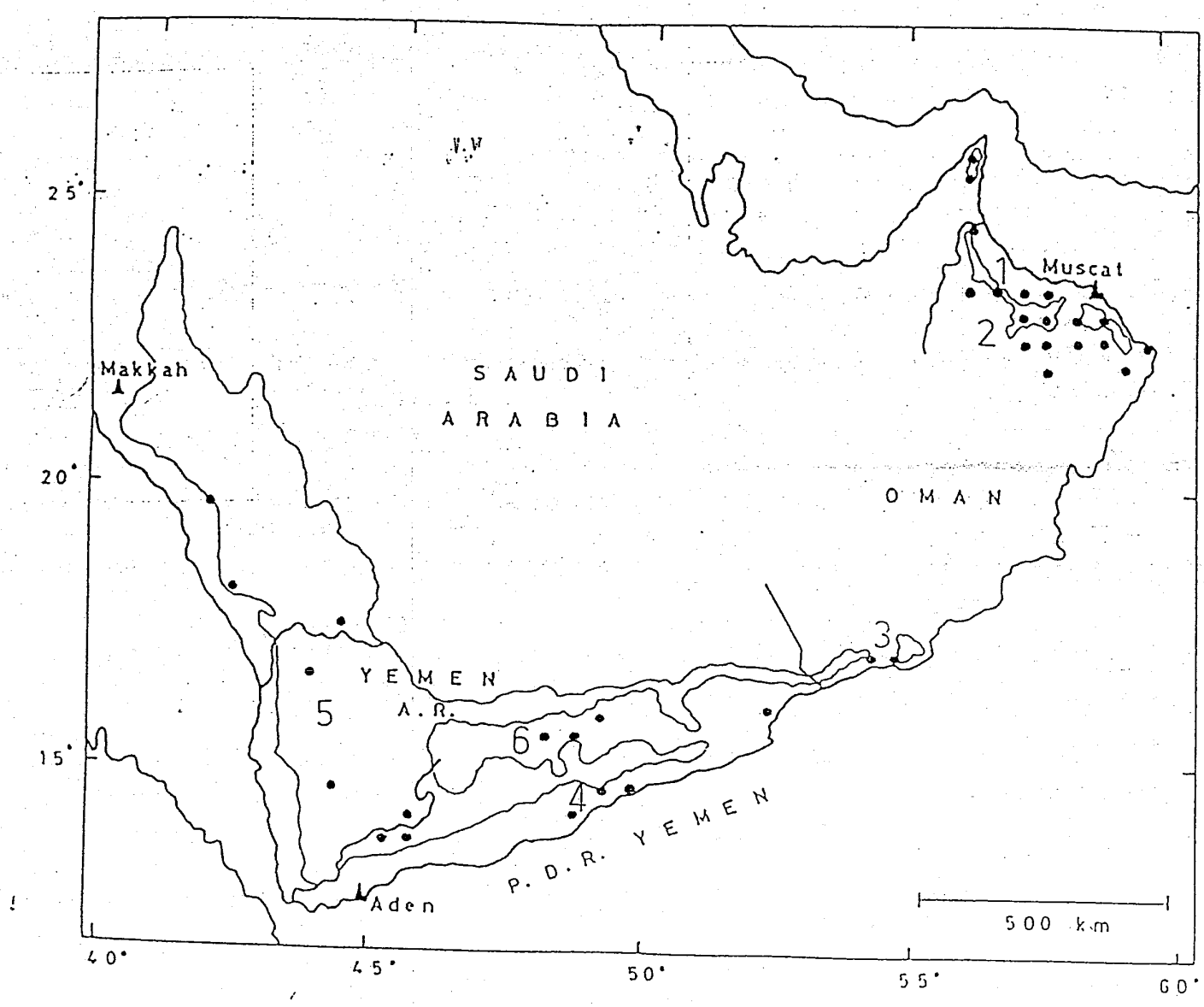


Figure 6. Map of the southern part of the Arabian Peninsula showing where alfalfa has been collected by collaborative missions involving national genetic resources programmes in the region and IBPGR. Circles mark those 30' latitude x 30' longitude sectors where at least one Medicago sativa collection has been made. Numbers 1-6 indicate the main agro-ecological zones where alfalfa is grown. The 1000 m contour is also shown.

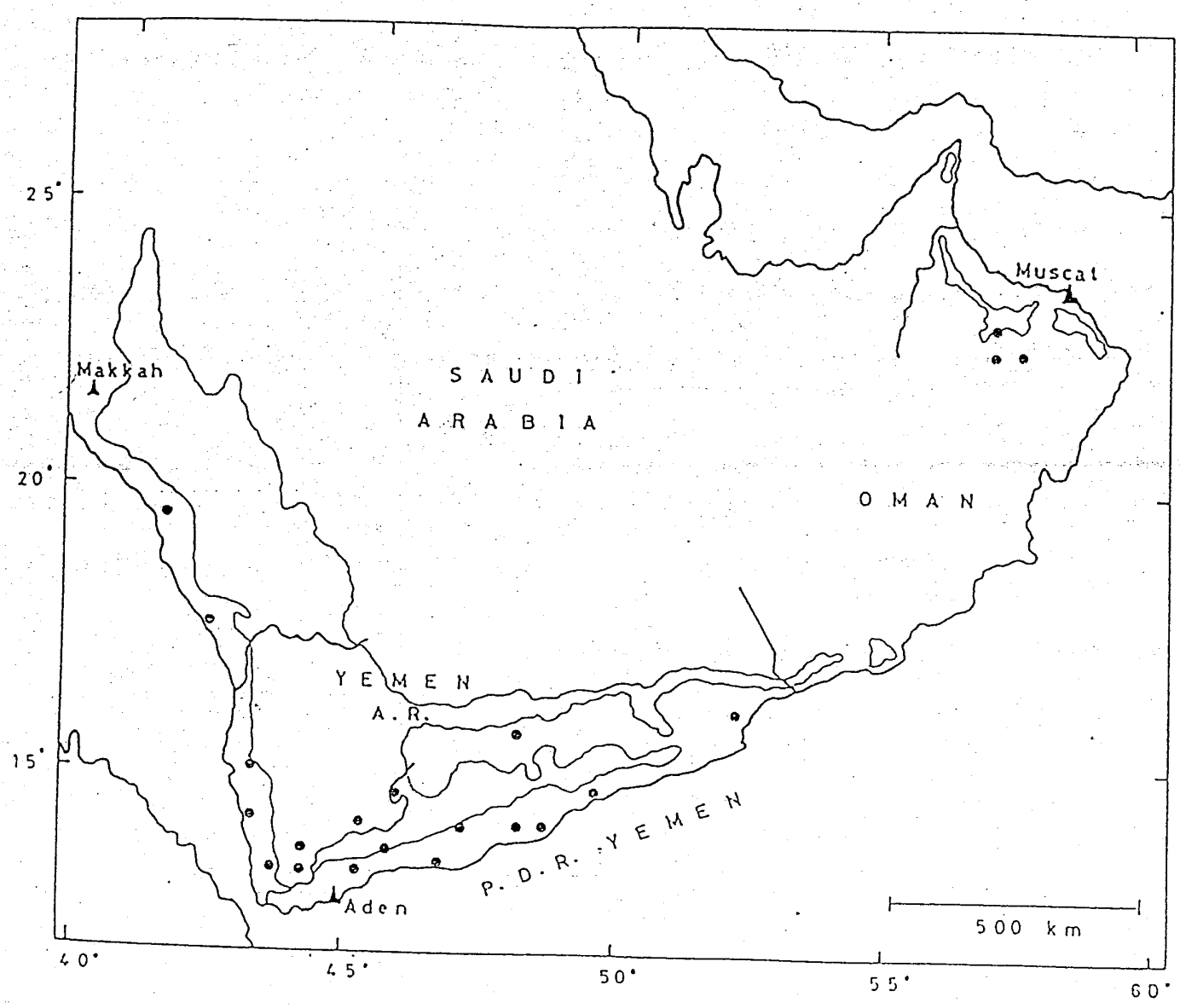
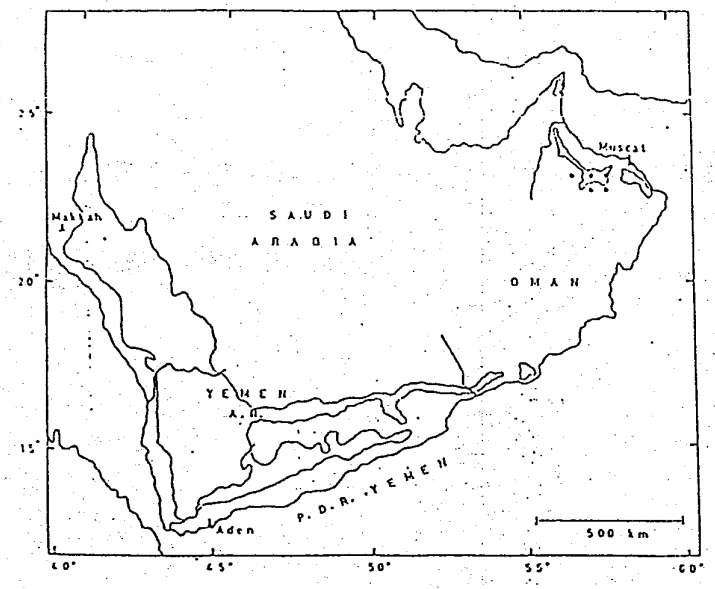
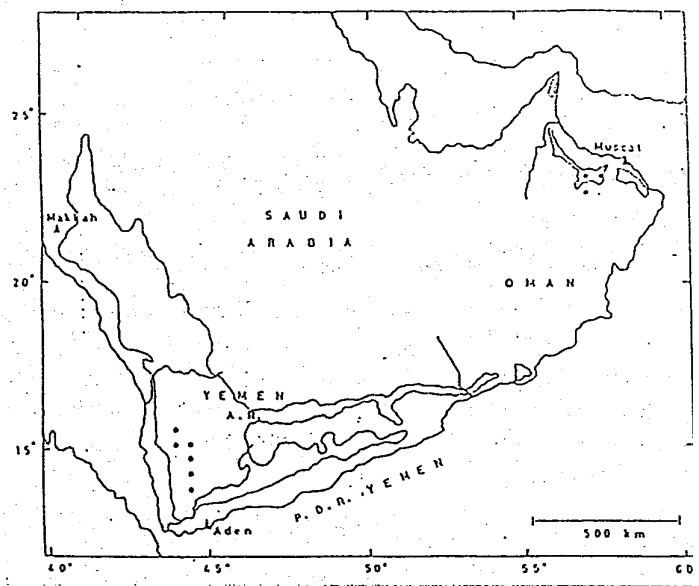


Figure 7. Map of the southern part of the Arabian Peninsula showing where sesame has been collected by collaborative missions involving national genetic resources programmes in the region and IBPGR. Circles mark those 30' latitude x 30' longitude sectors where at least one Sesamum indicum collection has been made. The 1000 m contour is also shown.

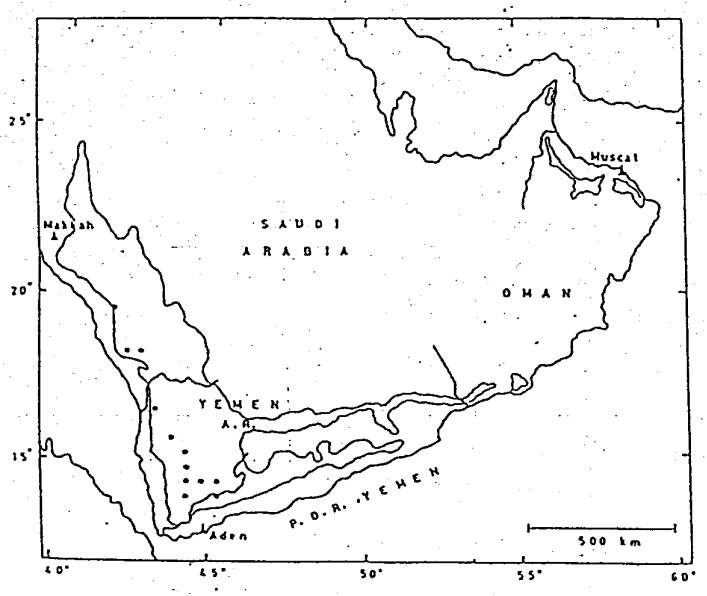
(a) Cicer arietinum



(b) Vicia faba



(c) Lens culinaris



(d) Pisum sativum

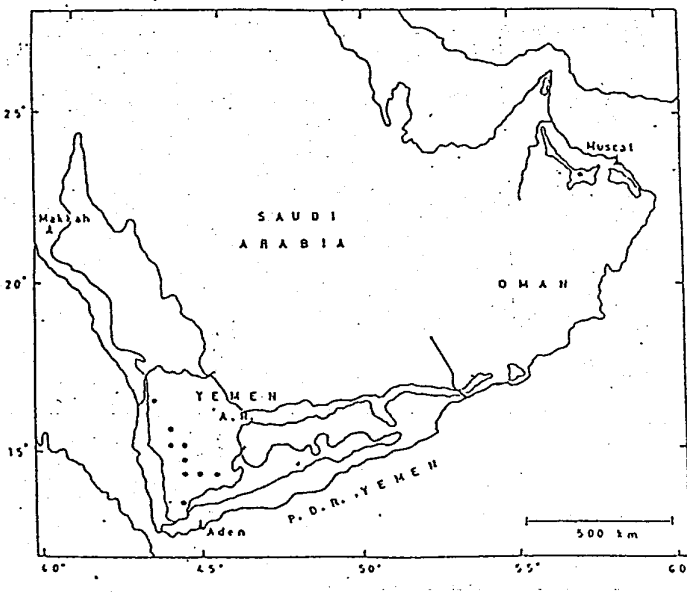
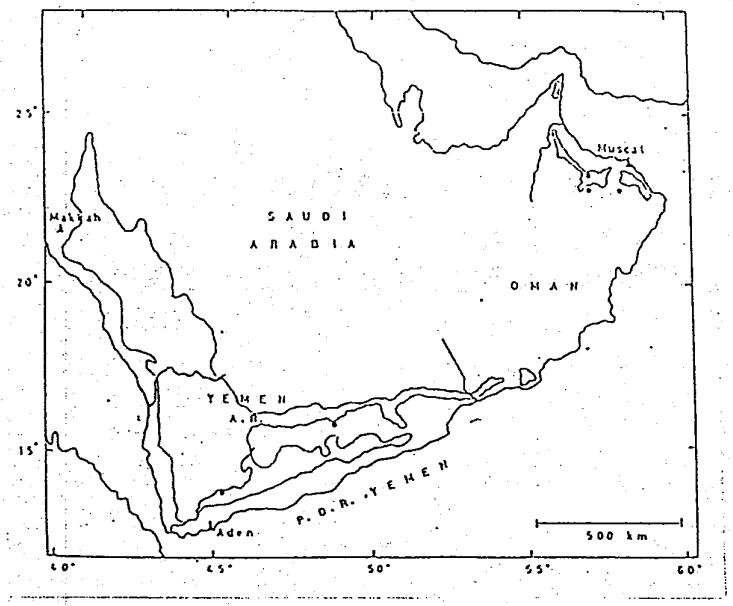
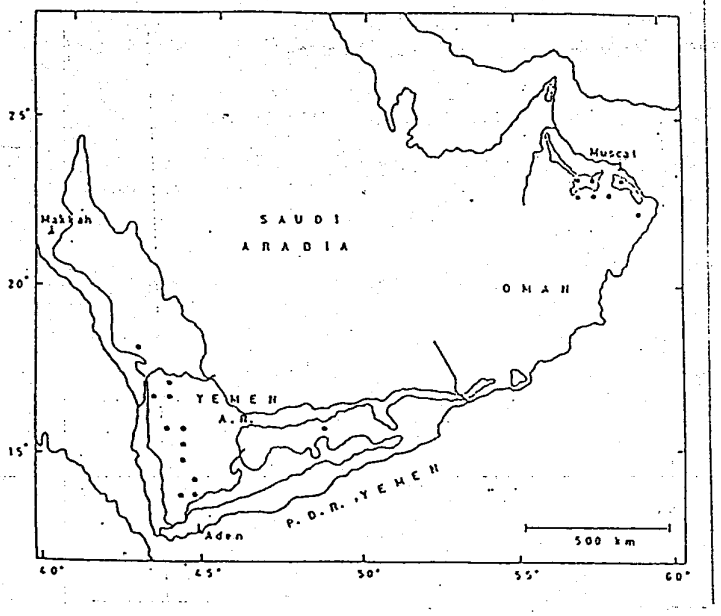


Figure 8 (a-i). Maps of the southern part of the Arabian Peninsula showing where grain legumes has been collected by collaborative missions involving national genetic resources programmes in the region and IBPGR. Circles mark those 30' latitude x 30' longitude sectors where at least one collection has been made. The 1000 m contour is also shown.

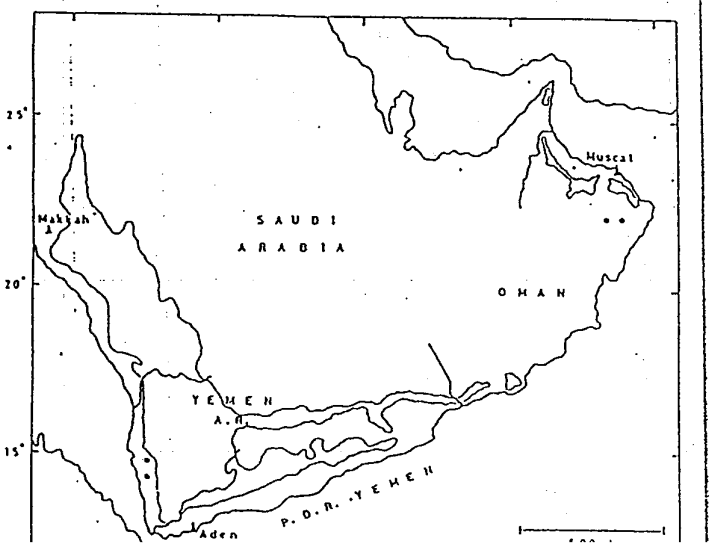
(c) Dolichos lablab



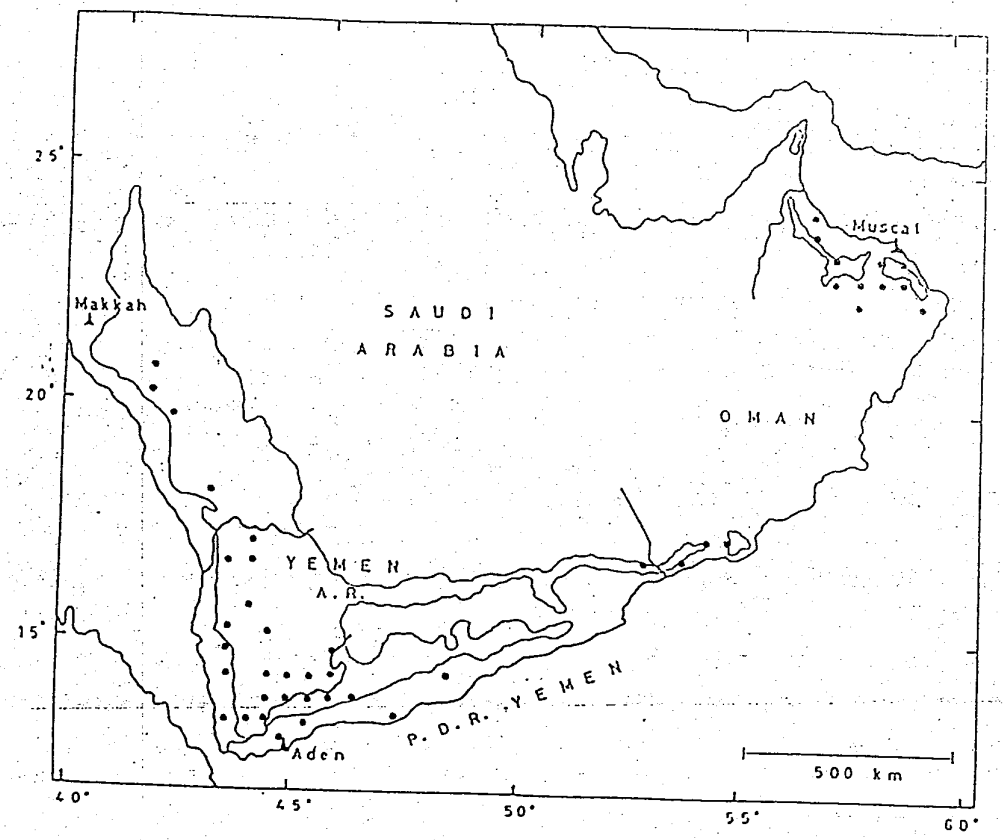
(f) Trigonella foenum-graecum



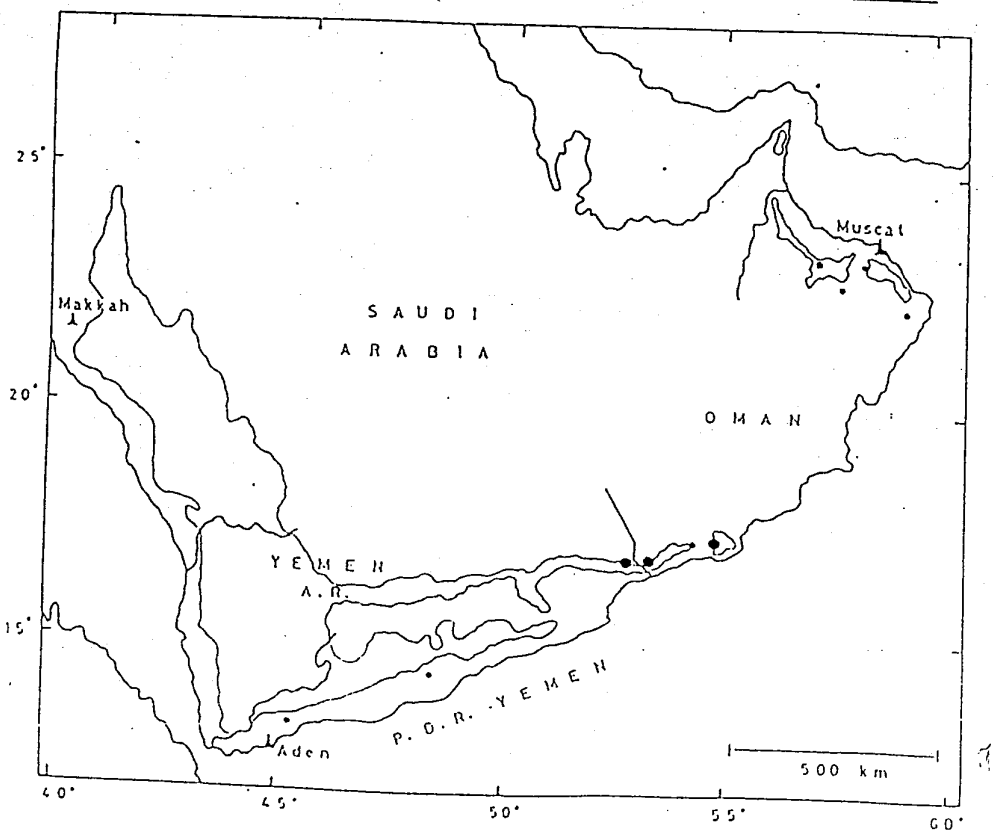
(g) Cajanus cajan



(h) Vigna unguiculata



(i) Vigna radiata (large circles are wild ssp. sublobata)



APPENDIX

Presented here are the following:

(1) List of collections made in P.D.R. Yemen during the 1988 mission, in **collection number order**.

(2) List of collections made in P.D.R. Yemen during the 1989a mission, in **collection number order**.

(3) List of collections made in P.D.R. Yemen during the 1989b mission, in **collection number order**.

(4) Complete list of **all** collections made in P.D.R. Yemen during the **1988, 1989a and 1989b** missions, arranged in **alphabetical order** on genus, species and variety.

Collections in P.D.R. Yemen - 1988

No.	Collectors	Species	Area	Govern.	Zone
1001	Guarino & Al Ghaz	Vigna radiata	Abyan delta	Abyan	1
1002	Guarino & Al Ghaz	Vigna unguiculata	Abyan delta	Abyan	1
1003	Guarino & Al Ghaz	Sorghum bicolor	Abyan delta	Abyan	1
1004	Guarino & Al Ghaz	Sesamum indicum	Abyan delta	Abyan	1
1005	Guarino & Al Ghaz	Pennisetum glaucum	Abyan delta	Abyan	1
1006	Guarino & Al Ghaz	Vigna unguiculata	Abyan delta	Abyan	1
1007	Guarino & Al Ghaz	Vigna radiata	Abyan delta	Abyan	1
1008	Guarino & Al Ghaz	Sorghum bicolor	Abyan delta	Abyan	1
1009	Guarino & Al Ghaz	Sesamum indicum	Abyan delta	Abyan	1
1010	Guarino & Al Ghaz	Sesamum indicum	Abyan delta	Abyan	1
1011	Guarino & Al Ghaz	Sesamum indicum	Abyan delta	Abyan	1
1012	Guarino & Al Ghaz	Sorghum bicolor	Abyan delta	Abyan	1
1013	Guarino & Al Ghaz	Vigna unguiculata	Abyan delta	Abyan	1
1014	Guarino & Al Ghaz	Vigna radiata	Abyan delta	Abyan	1
1015	Guarino & Al Ghaz	Pennisetum glaucum	Abyan delta	Abyan	1
1016	Guarino & Al Ghaz	Vigna unguiculata	Abyan delta	Abyan	1
1017	Guarino & Al Ghaz	Pennisetum glaucum	Abyan delta	Abyan	1
1018	Guarino & Al Ghaz	Sorghum bicolor	Ahwar delta	Abyan	1
1019	Guarino & Al Ghaz	Pennisetum glaucum	Ahwar delta	Abyan	1
1020	Guarino & Al Ghaz	Vigna unguiculata	Ahwar delta	Abyan	1
1021	Guarino & Al Ghaz	Sesamum indicum	Ahwar delta	Abyan	1
1022	Guarino & Al Ghaz	Pennisetum glaucum	Ahwar delta	Abyan	1
1023	Guarino & Al Ghaz	Sesamum indicum	Ahwar delta	Abyan	1
1024	Guarino & Al Ghaz	Sorghum bicolor	Ahwar delta	Abyan	1
1025	Guarino & Al Ghaz	Sorghum bicolor	Ahwar delta	Abyan	1
1026	Guarino & Al Ghaz	Pennisetum glaucum	Ahwar delta	Abyan	1
1027	Guarino & Al Ghaz	Sorghum bicolor	Ahwar delta	Abyan	1
1028	Guarino & Al Ghaz	Sorghum bicolor	Ahwar delta	Abyan	1
1029	Guarino & Al Ghaz	Sorghum bicolor	Abyan coast	Abyan	1
1030	Guarino & Al Ghaz	Sorghum bicolor	Abyan coast	Abyan	1
1031	Guarino & Al Ghaz	Pennisetum glaucum	Abyan coast	Abyan	1
1032	Guarino & Al Ghaz	Sorghum bicolor	Abyan coast	Abyan	1
1033	Guarino & Al Ghaz	Pennisetum glaucum	Abyan coast	Abyan	1
1034	Guarino & Al Ghaz	Sorghum bicolor	Abyan delta	Abyan	1
1035	Guarino & Al Ghaz	Sorghum bicolor	Abyan delta	Abyan	1
1036	Guarino & Al Ghaz	Sorghum bicolor	Abyan delta	Abyan	1
1037	Guarino & Al Chaz	Vigna unguiculata	Abyan delta	Abyan	1
1038	Guarino & Al Ghaz	Vigna radiata	Abyan delta	Abyan	1
1039	Guarino & Al Ghaz	Pennisetum glaucum	Abyan delta	Abyan	1
1040	Guarino & Al Ghaz	Vigna unguiculata	Abyan delta	Abyan	1
1041	Guarino & Al Ghaz	Vigna radiata	Abyan delta	Abyan	1
1042	Guarino & Al Ghaz	Sorghum bicolor	Abyan delta	Abyan	1
1043	Guarino & Al Ghaz	Sorghum bicolor	Abyan delta	Abyan	1
1044	Guarino & Al Ghaz	Vigna unguiculata	Abyan delta	Abyan	1
1045	Guarino & Al Ghaz	Vigna radiata	Abyan delta	Abyan	1
1046	Guarino & Al Ghaz	Sorghum bicolor	Abyan delta	Abyan	1
1047	Guarino & Al Ghaz	Sorghum bicolor	Abyan delta	Abyan	1
1048	Guarino & Al Ghaz	Sorghum bicolor	Abyan delta	Abyan	1
1049	Guarino & Al Ghaz	Pennisetum glaucum	Lawdar plain	Abyan	3
1050	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1051	Guarino & Al Ghaz	Vigna unguiculata	Lawdar plain	Abyan	3
1052	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1053	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3

1054	Guarino & Al Ghaz	Dactyloctenium scindicum	Lawdar plain	Abyan	3
1055	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1056	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1057	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1058	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1059	Guarino & Al Ghaz	Sesamum indicum	Lawdar plain	Abyan	3
1060	Guarino & Al Ghaz	Pennisetum glaucum	Lawdar plain	Abyan	3
1061	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1062	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1063	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1064	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1065	Guarino & Al Ghaz	Pennisetum glaucum	Lawdar plain	Abyan	3
1066	Guarino & Al Ghaz	Pennisetum glaucum	Lawdar plain	Abyna	3
1067	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1068	Guarino & Al Ghaz	Vigna unguiculata	Lawdar plain	Abyan	3
1069	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1070	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1071	Guarino & Al Ghaz	Hordeum vulgare	Mukeiras	Abyan	4
1072	Guarino & Al Ghaz	Sorghum bicolor	Mukeiras	Abyan	4
1073	Guarino & Al Ghaz	Hordeum vulgare	Mukeiras	Abyan	4
1074	Guarino & Al Ghaz	Sorghum bicolor	Mukeiras	Abyan	4
1075	Guarino & Al Ghaz	Triticum aestivum	Mukeiras	Abyan	4
1076	Guarino & Al Ghaz	Triticum aestivum	Mukeiras	Abyan	4
1077	Guarino & Al Ghaz	Sorghum bicolor	Mukeiras	Abyan	4
1078	Guarino & Al Ghaz	Vigna unguiculata	Mukeiras	Abyan	4
1079	Guarino & Al Ghaz	Hordeum vulgare	Mukeiras	Abyan	4
1080	Guarino & Al Ghaz	Medicago sativa	Mukeiras	Abyan	4
1081	Guarino & Al Ghaz	Hordeum vulgare	Mukeiras	Abyan	4
1082	Guarino & Al Ghaz	Pennisetum glaucum	Mukeiras	Abyan	4
1083	Guarino & Al Ghaz	Vigna unguiculata	Lawdar plain	Abyan	3
1084	Guarino & Al Ghaz	Pennisetum glaucum	Lawdar plain	Abyan	3
1085	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1086	Guarino & Al Ghaz	Pennisetum glaucum	Lawdar plain	Abyan	3
1087	Guarino & Al Ghaz	Vigna unguiculata	Lawdar plain	Abyan	3
1088	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1089	Guarino & Al Ghaz	Dactyloctenium scindicum	Lawdar plain	Abyan	3
1090	Guarino & Al Ghaz	Pennisetum glaucum	Lawdar plain	Abyan	3
1091	Guarino & Al Ghaz	Sorghum bicolor	Lawdar plain	Abyan	3
1092	Guarino & Al Ghaz	Pennisetum glaucum	Naqabah	Shabwa	3
1093	Guarino & Al Ghaz	Sorghum bicolor	Ataq	Shabwa	3
1094	Guarino & Al Ghaz	Sorghum bicolor	Ataq	Shabwa	3
1095	Guarino & Al Ghaz	Pennisetum glaucum	Nisab	Shabwa	3
1096	Guarino & Al Ghaz	Sorghum bicolor	Nisab	Shabwa	3
1097	Guarino & Al Ghaz	Triticum aestivum	Nisab	Shabwa	3
1098	Guarino & Al Ghaz	Sorghum bicolor	Nisab	Shabwa	3
1099	Guarino & Al Ghaz	Pennisetum glaucum	Nisab	Shabwa	3
1100	Guarino & Al Ghaz	Pennisetum glaucum	Nisab	Shabwa	3
1101	Guarino & Al Ghaz	Sorghum bicolor	Nisab	Shabwa	3
1102	Guarino & Al Ghaz	Sorghum bicolor	Nisab	Shabwa	3
1103	Guarino & Al Ghaz	Pennisetum glaucum	Beihan	Shabwa	3
1104	Guarino & Al Ghaz	Sorghum bicolor	Beihan	Shabwa	3
1105	Guarino & Al Ghaz	Sesamum indicum	Beihan	Shabwa	3
1106	Guarino & Al Ghaz	Sorghum bicolor	Beihan	Shabwa	3
1107	Guarino & Al Ghaz	Gossypium sp.	Beihan	Shabwa	3
1108	Guarino & Al Ghaz	Brassica nigra	Beihan	Shabwa	3
1109	Guarino & Al Ghaz	Hordeum vulgare	Beihan	Shabwa	3
1110	Guarino & Al Ghaz	Hordeum vulgare	Beihan	Shabwa	3
1111	Guarino & Al Ghaz	Sorghum bicolor	Beihan	Shabwa	3

1112	Guarino & Al Ghaz	Pennisetum glaucum	Beihan	Shabwa	3
1113	Guarino & Al Ghaz	Triticum aestivum	Beihan	Shabwa	3
1114	Guarino & Al Ghaz	Sorghum bicolor	Beihan	Shabwa	3
1115	Guarino & Al Ghaz	Setaria italica	Beihan	Shabwa	3
1116	Guarino & Al Ghaz	Vigna unguiculata	Beihan	Shabwa	3
1117	Guarino & Al Ghaz	Sorghum bicolor	Beihan	Shabwa	3
1118	Guarino & Al Ghaz	Sorghum bicolor	Beihan	Shabwa	3
1119	Guarino & Al Ghaz	Sorghum bicolor	Beihan	Shabwa	3
1120	Guarino & Al Ghaz	Sorghum bicolor	Beihan	Shabwa	3
1121	Guarino & Al Ghaz	Sorghum bicolor	Naqabah	Shabwa	3
1122	Guarino & Al Ghaz	Sorghum bicolor	Naqabah	Shabwa	3
1123	Guarino & Al Ghaz	Sorghum bicolor	Naqabah	Shabwa	3
1124	Guarino & Al Ghaz	Sesamum indicum	Naqabah	Shabwa	3
1125	Guarino & Al Ghaz	Pennisetum glaucum	Naqabah	Shabwa	3
1126	Guarino & Al Ghaz	Sorghum bicolor	Wadi Maifaa	Shabwa	3
1127	Guarino & Al Ghaz	Sesamum indicum	Wadi Maifaa	Shabwa	3
1128	Guarino & Al Ghaz	Pennisetum glaucum	Wadi Maifaa	Shabwa	3
1129	Guarino & Al Ghaz	Sorghum bicolor	Naqabah	Shabwa	3
1130	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1131	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1132	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1133	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1134	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1135	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1136	Guarino & Al Ghaz	Dolichos lablab	W. Hadramawt	Hadramawt	2
1137	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1138	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1139	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1140	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1141	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1142	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1143	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1144	Guarino & Al Ghaz	Medicago sativa	W. Hadramawt	Hadramawt	2
1145	Guarino & Al Ghaz	Raphanus sativus	W. Hadramawt	Hadramawt	2
1146	Guarino & Al Ghaz	Eleusine coracana	W. Hadramawt	Hadramawt	2
1147	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1148	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1149	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1150	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1151	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1152	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1154	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1155	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1156	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1157	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1158	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1159	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1160	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1161	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1162	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1163	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1164	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1165	Guarino & Al Ghaz	Medicago sativa	W. Hadramawt	Hadramawt	2
1166	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1167	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
1168	Guarino & Al Ghaz	Medicago sativa	W. Hadramawt	Hadramawt	2
1169	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
1170	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2

171	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
172	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
173	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
174	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
175	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
176	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
177	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
178	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
179	Guarino & Al Ghaz	Coriandrum sativum	W. Hadramawt	Hadramawt	2
180	Guarino & Al Ghaz	Medicago sativa	W. Hadramawt	Hadramawt	2
181	Guarino & Al Ghaz	Trigonella foenum-graecum	W. Hadramawt	Hadramawt	2
182	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
183	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
184	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
185	Guarino & Al Ghaz	Spice (Habba sauda)	W. Hadramawt	Hadramawt	2
186	Guarino & Al Ghaz	Sesamum indicum	W. Hadramawt	Hadramawt	2
187	Guarino & Al Ghaz	Medicago sativa	W. Hadramawt	Hadramawt	2
188	Guarino & Al Ghaz	Triticum aestivum	W. Hadramawt	Hadramawt	2
189	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
190	Guarino & Al Ghaz	Allium cepa	W. Hadramawt	Hadramawt	2
191	Guarino & Al Ghaz	Sorghum bicolor	W. Hadramawt	Hadramawt	2
192	Guarino & Al Ghaz	Medicago sativa	W. Hadramawt	Hadramawt	2
193	Guarino & Al Ghaz	Sesamum indicum	W. Hadramawt	Hadramawt	2
194	Guarino & Al Ghaz	Coriandrum sativum	W. Hadramawt	Hadramawt	2
195	Guarino & Al Ghaz	Medicago sativa	Hadramawt coast	Hadramawt	1
196	Guarino & Al Ghaz	Raphanus sativus	Hadramawt coast	Hadramawt	1
197	Guarino & Al Ghaz	Pennisetum glaucum	Hadramawt coast	Hadramawt	1
198	Guarino & Al Ghaz	Vegetable (Rejlah)	Hadramawt coast	Hadramawt	1
199	Guarino & Al Ghaz	Nicotiana tabacum	Hadramawt coast	Hadramawt	1
200	Guarino & Al Ghaz	Sorghum bicolor	Hadramawt coast	Hadramawt	1
201	Guarino & Al Ghaz	Medicago sativa	Hadramawt coast	Hadramawt	1
202	Guarino & Al Ghaz	Sorghum bicolor	Hadramawt coast	Hadramawt	1
203	Guarino & Al Ghaz	Allium cepa	Hadramawt coast	Hadramawt	1
204	Guarino & Al Ghaz	Pennisetum glaucum	Hadramawt coast	Hadramawt	1
205	Guarino & Al Ghaz	Medicago sativa	Hadramawt coast	Hadramawt	1
206	Guarino & Al Ghaz	Pennisetum glaucum	Hadramawt coast	Hadramawt	1
207	Guarino & Al Ghaz	Allium cepa	Hadramawt coast	Hadramawt	1
208	Guarino & Al Ghaz	Vegetable (Rejlah)	Hadramawt coast	Hadramawt	1
209	Guarino & Al Ghaz	Luffa sp.	Hadramawt coast	Hadramawt	1
210	Guarino & Al Ghaz	Medicago sativa	Hadramawt coast	Hadramawt	1
211	Guarino & Al Ghaz	Sorghum bicolor	Hadramawt coast	Hadramawt	1
212	Guarino & Al Ghaz	Eragrostis teff	Hadramawt coast	Hadramawt	1
213	Guarino & Al Ghaz	Sesamum indicum	Hadramawt coast	Hadramawt	1
214	Guarino & Al Ghaz	Pennisetum glaucum	Hadramawt coast	Hadramawt	1
215	Guarino & Al Ghaz	Raphanus sativus	Hadramawt coast	Hadramawt	1
216	Guarino & Al Ghaz	Sorghum bicolor	Hadramawt coast	Hadramawt	1
217	Guarino & Al Ghaz	Medicago sativa	Hadramawt coast	Hadramawt	1
218	Guarino & Al Ghaz	Medicago sativa	Hadramawt coast	Hadramawt	1
219	Guarino & Al Ghaz	Allium cepa	Ghail Bawazir	Hadramawt	1
220	Guarino & Al Ghaz	Eleusine coracana	Ghail Bawazir	Hadramawt	1
221	Guarino & Al Ghaz	Medicago sativa	Ghail Bawazir	Hadramawt	1
222	Guarino & Al Ghaz	Lycopersicon esculentum	Ghail Bawazir	Hadramawt	1
223	Guarino & Al Ghaz	Allium cepa	Ghail Bawazir	Hadramawt	1
224	Guarino & Al Ghaz	Sorghum bicolor	Ghail Bawazir	Hadramawt	1
225	Guarino & Al Ghaz	Pennisetum glaucum	Ghail Bawazir	Hadramawt	1
226	Guarino & Al Ghaz	Raphanus sativus	Ghail Bawazir	Hadramawt	1
227	Guarino & Al Ghaz	Luffa sp.	Ghail Bawazir	Hadramawt	1
228	Guarino & Al Ghaz	Cucurbita sp.	Ghail Bawazir	Hadramawt	1

1229	Guarino & Al Ghaz	Abelmoschus esculentus	Ghail Bawazir	Hadramawt	1
1230	Guarino & Al Ghaz	Amaranthus sp.	Ghail Bawazir	Hadramawt	1
1231	Guarino & Al Ghaz	Abelmoschus esculentus	Ghail Bawazir	Hadramawt	1
1232	Guarino & Al Ghaz	Allium cepa	Ghail Bawazir	Hadramawt	1
1233	Guarino & Al Ghaz	Medicago sativa	Ghail Bawazir	Hadramawt	1
1234	Guarino & Al Ghaz	Raphanus sativus	Ghail Bawazir	Hadramawt	1
1235	Guarino & Al Ghaz	Capsicum annuum	Ghail Bawazir	Hadramawt	1
1236	Guarino & Al Ghaz	Sorghum bicolor	Dhala	Lahej	4
1236a	Guarino & Al Ghaz	Medicago sativa	Ghail Bawazir	Hadramawt	1
1237	Guarino & Al Ghaz	Sorghum bicolor	Dhala	Lahej	4
1237a	Guarino & Al Ghaz	Sorghum bicolor	Ghail Bawazir	Hadramawt	1
1238	Guarino & Al Ghaz	Pennisetum glaucum	Dhala	Lahej	4
1239	Guarino & Al Ghaz	Sorghum bicolor	Dhala	Lahej	4
1240	Guarino & Al Ghaz	Sorghum bicolor	Dhala	Lahej	4
1241	Guarino & Al Ghaz	Sorghum bicolor	Dhala	Lahej	4
1242	Guarino & Al Ghaz	Sorghum bicolor	Dhala	Lahej	4
1243	Guarino & Al Ghaz	Pennisetum glaucum	Dhala	Lahej	4
1244	Guarino & Al Ghaz	Sorghum bicolor	Dhala	Lahej	4
1245	Guarino & Al Ghaz	Sorghum bicolor	Dhala	Lahej	4
1246	Guarino & Al Ghaz	Sorghum bicolor	Dhala	Lahej	4
1247	Guarino & Al Ghaz	Sorghum bicolor	Dhala	Lahej	4
1248	Guarino & Al Ghaz	Phaseolus sp.	Dhala	Lahej	4
1249	Guarino & Al Ghaz	Vigna unguiculata	Dhala	Lahej	4
1250	Guarino & Al Ghaz	Brassica nigra	Dhala	Lahej	4
1251	Guarino & Al Ghaz	Sorghum bicolor	Dhala	Lahej	4
1252	Guarino & Al Ghaz	Sorghum bicolor	Dhala	Lahej	4
1253	Guarino & Al Ghaz	Trigonella foenum-graecum	Dhala	Lahej	4
1254	Guarino & Al Ghaz	Zea mays	Dhala	Lahej	4
1255	Guarino & Al Ghaz	Hordeum vulgare	Dhala	Lahej	4
1256	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1257	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1258	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1259	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1260	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1261	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1263	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1264	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1265	Guarino & Al Ghaz	Vigna unguiculata	Tuban delta	Lahej	1
1266	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1267	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1268	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1269	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1270	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1271	Guarino & Al Ghaz	Sorghum bicolor	Tuban delta	Lahej	1
1272	Guarino & Al Ghaz	Pennisetum glaucum	Tuban delta	Lahej	1

Collections in P.D.R. Yemen - 1989a

No.	Collectors	Species	Area	Govern.	Zone
12001	Guarino, Obadi & Miller	Alysicarpus glumaceus	Lawdar plain	Abyan	3
12002	Guarino, Obadi & Miller	Acacia hamulosa	Wadi Hajr	Hadramawt	1
12003	Guarino, Obadi & Miller	Taverniera sp. nov.	Wadi Hajr	Hadramawt	1
12004	Guarino, Obadi & Miller	Vigna unguiculata	Wadi Hajr	Hadramawt	1/2
12005	Guarino, Obadi & Miller	Vigna radiata	Wadi Hajr	Hadramawt	1/2
12006	Guarino, Obadi & Miller	Sorghum bicolor	Wadi Hajr	Hadramawt	1/2
12007	Guarino, Obadi & Miller	Eragrostis teff	Wadi Hajr	Hadramawt	1/2
12008	Guarino, Obadi & Miller	Sesamum indicum	Wadi Hajr	Hadramawt	1/2
12009	Guarino, Obadi & Miller	Eleusine coracana	Wadi Hajr	Hadramawt	1/2
12010	Guarino, Obadi & Miller	Pennisetum glaucum	Wadi Hajr	Hadramawt	1/2
12011	Guarino, Obadi & Miller	Corchorus erodioides	Socotra	Aden	
12012	Guarino, Obadi & Miller	Teramnus repens	Socotra	Aden	
12013	Guarino, Obadi & Miller	Dactyloctenium aristatum	Socotra	Aden	
12014	Guarino, Obadi & Miller	Acacia edgeworthii	Socotra	Aden	
12015	Guarino, Obadi & Miller	Dactyloctenium sp.	Socotra	Aden	
12016	Guarino, Obadi & Miller	Tephrosia sp.	Socotra	Aden	
12017	Guarino, Obadi & Miller	Punica protopunica	Socotra	Aden	
12018	Guarino, Obadi & Miller	Punica protopunica	Socotra	Aden	
12019	Guarino, Obadi & Miller	Medicago laciniata	Socotra	Aden	
12020	Guarino, Obadi & Miller	Dactyloctenium sp.	Socotra	Aden	
12021	Guarino, Obadi & Miller	Cenchrus pennisetiformis	Socotra	Aden	
12022	Guarino, Obadi & Miller	Dactyloctenium aristatum	Socotra	Aden	
12023	Guarino, Obadi & Miller	Gramineae	Socotra	Aden	
12024	Guarino, Obadi & Miller	Dactyloctenium sp.	Socotra	Aden	
12025	Guarino, Obadi & Miller	Cylista schweinfurthii	Socotra	Aden	

12026	Guarino, Obadi & Miller	Ormocarpum sp. nov.	Socotra	Aden	
12027	Guarino, Obadi & Miller	Indigofera pseudointricata	Socotra	Aden	
12028	Guarino, Obadi & Miller	Eleusine coracana	Socotra	Aden	1
12029	Guarino, Obadi & Miller	Ormocarpum caeruleum	Socotra	Aden	
12030	Guarino, Obadi & Miller	Punica proropunica	Socotra	Aden	
12031	Guarino, Obadi & Miller	Arthrocarpum gracile	Socotra	Aden	
12032	Guarino, Obadi & Miller	Tephrosia apollinea	Socotra	Aden	
12033	Guarino, Obadi & Miller	Lotus ononopsis	Socotra	Aden	
12034	Guarino, Obadi & Miller	Heteropogon contortus	Socotra	Aden	
12035	Guarino, Obadi & Miller	Punica protopunica	Socotra	Aden	
12036	Guarino, Obadi & Miller	Citrus aurantium	Socotra	Aden	
12037	Guarino, Obadi & Miller	Begonia socotrana	Socotra	Aden	
12038	Guarino, Obadi & Miller	Punica protopunica	Socotra	Aden	
12039	Guarino, Obadi & Miller	Acacia tortilis?	Socotra	Aden	
12040	Guarino, Obadi & Miller	Dendrosicyos socotranus	Socotra	Aden	
12041	Guarino, Obadi & Miller	Acacia edgeworthii	Socotra	Aden	
12042	Guarino, Obadi & Miller	Acacia aff. oerfota	Socotra	Aden	
12043	Guarino, Obadi & Miller	Dactyloctenium aegyptium	Socotra	Aden	
12044	Guarino, Obadi & Miller	Exacum affine	Socotra	Aden	

Collections in P.D.R. Yemen - 1989b

No.	Collectors	Species	Area	Govern.	2
16001	Guarino & Balaidi	Acacia tortilis	Qishn	Mahra	1
16002	Guarino & Balaidi	Acacia sp.	Qishn	Mahra	1
16003	Guarino & Balaidi	Acacia sp.	Qishn	Mahra	1
16004	Guarino & Balaidi	Pennisetum sp.	Qishn	Mahra	1
16005	Guarino & Balaidi	Pennisetum sp.	Qishn	Mahra	1
16006	Guarino & Balaidi	Sorghum bicolor	Qishn	Mahra	1
16007	Guarino & Balaidi	Sorghum bicolor	Qishn	Mahra	1
16008	Guarino & Balaidi	Pennisetum sp.	Qishn	Mahra	1
16009	Guarino & Balaidi	Sorghum bicolor	Al Ghaydah	Mahra	1
16010	Guarino & Balaidi	Vigna unguiculata	Hauf	Mahra	5
16011	Guarino & Balaidi	Sorghum bicolor	Hauf	Mahra	5
16012	Guarino & Balaidi	Anogeissus dhofarica	Hauf	Mahra	5
16013	Guarino & Balaidi	Alysicarpus sp.	Hauf	Mahra	5
16014	Guarino & Balaidi	Sorghum bicolor	Hauf	Mahra	5
16015	Guarino & Balaidi	Cucumis sativus	Hauf	Mahra	5
16016	Guarino & Balaidi	Malvaceae	Hauf	Mahra	5
16017	Guarino & Balaidi	Sorghum bicolor	Hauf	Mahra	5
16018	Guarino & Balaidi	Vigna unguiculata	Hauf	Mahra	5
16019	Guarino & Balaidi	Abelmoschus esculentus	Hauf	Mahra	5
16020	Guarino & Balaidi	Vigna radiata	Hauf	Mahra	5
16021	Guarino & Balaidi	Vatovaea pseudolablab	Hauf	Mahra	5
16022	Guarino & Balaidi	Anogeissus dhofarica	Hauf	Mahra	5
16023	Guarino & Balaidi	Woody subshrub	Hauf	Mahra	5
16024	Guarino & Balaidi	Cenchrus setigerus	Hauf	Mahra	5
16025	Guarino & Balaidi	Dactyloctenium scindicum	Damqwat	Mahra	1
16026	Guarino & Balaidi	Boswellia sacra	Damqwat	Mahra	1
16027	Guarino & Balaidi	Dactyloctenium scindicum	Damqwat	Mahra	1
16028	Guarino & Balaidi	Cenchrus pennisetiformis	Damqwat	Mahra	1
16029	Guarino & Balaidi	Cenchrus setigerus	Damqwat	Mahra	1
16030	Guarino & Balaidi	Gossypium stocksii	Damqwat	Mahra	1
16031	Guarino & Balaidi	Caralluma sp	Damqwat	Mahra	1
16032	Guarino & Balaidi	Rhynchosia sp.	Damqwat	Mahra	1
16033	Guarino & Balaidi	Pennisetum sp.	Damqwat	Mahra	1
16034	Guarino & Balaidi	Sorghum bicolor	Damqwat	Mahra	1
16035	Guarino & Balaidi	Abelmoschus esculentus	Damqwat	Mahra	1
16035a	Guarino & Balaidi	Vatovaea pseudolablab	Hauf	Mahra	5
16036	Guarino & Balaidi	Legume H52	Hauf	Mahra	5
16037	Guarino & Balaidi	Luffa H53	Hauf	Mahra	5
16038	Guarino & Balaidi	Rhynchosia	Hauf	Mahra	5
16039	Guarino & Balaidi	Dactyloctenium aristatum	Hauf	Mahra	5
16040	Guarino & Balaidi	Alysicarpus	Hauf	Mahra	5
16041	Guarino & Balaidi	Dactyloctenium scindicum	Hauf	Mahra	5
16042	Guarino & Balaidi	Vigna unguiculata	Hauf	Mahra	5
16043	Guarino & Balaidi	Taverniera	Hauf	Mahra	5
16044	Guarino & Balaidi	Sorghum bicolor	Hauf	Mahra	5
16045	Guarino & Balaidi	Anogeissus dhofarica	Hauf	Mahra	5
16046	Guarino & Balaidi	Sorghum bicolor	Hauf	Mahra	5
16047	Guarino & Balaidi	Rhynchosia	Hauf	Mahra	5
16048	Guarino & Balaidi	Avicennia	Nishtun	Mahra	1

16049	Guarino & Balaidi	Sorghum bicolor	Al Ghaydah	Mahra	1
16050	Guarino & Balaidi	Sorghum bicolor	Al Ghaydah	Mahra	1
16051	Guarino & Balaidi	Sorghum bicolor	Al Ghaydah	Mahra	1
16052	Guarino & Balaidi	Sorghum bicolor	Al Ghaydah	Mahra	1
16053	Guarino & Balaidi	Sesamum indicum	Al Ghaydah	Mahra	1
16054	Guarino & Balaidi	Medicago sativa	Al Ghaydah	Mahra	1
16055	Guarino & Balaidi	Pennisetum sp.	Al Ghaydah	Mahra	1
16057	Guarino & Balaidi	Pennisetum sp.	Al Ghaydah	Mahra	1
16057	Guarino & Balaidi	Cucumis sativus	Hauf	Mahra	5
16057a	Guarino, Al Ghaz & Winkel	Pennisetum glaucum	Wadi Watan	Lahej	3
16058	Guarino, Al Ghaz & Winkel	Pennisetum glaucum	Wadi Watan	Lahej	3
16059	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Wadi Watan	Lahej	3
16060	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Wadi Watan	Lahej	3
16061	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Wadi Watan	Lahej	3
16062	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16063	Guarino, Al Ghaz & Winkel	Vigna unguiculata	Yafaa	Lahej	4
16064	Guarino, Al Ghaz & Winkel	Lablab purpureus	Yafaa	Lahej	4
16065	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16066	Guarino, Al Ghaz & Winkel	Zea mays	Yafaa	Lahej	4
16067	Guarino, Al Ghaz & Winkel	Lens culinaris	Yafaa	Lahej	4
16068	Guarino, Al Ghaz & Winkel	Hordeum vulgare	Yafaa	Lahej	4
16069	Guarino, Al Ghaz & Winkel	Vigna unguiculata	Yafaa	Lahej	4
16070	Guarino, Al Ghaz & Winkel	Triticum aestivum	Yafaa	Lahej	4
16071	Guarino, Al Ghaz & Winkel	Pennisetum glaucum	Yafaa	Lahej	4
16072	Guarino, Al Ghaz & Winkel	Medicago sativa	Yafaa	Lahej	4
16073	Guarino, Al Ghaz & Winkel	Allium sativum	Yafaa	Lahej	4
16074	Guarino, Al Ghaz & Winkel	Lens culinaris	Yafaa	Lahej	4
16075	Guarino, Al Ghaz & Winkel	Hordeum vulgare	Yafaa	Lahej	4
16076	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16077	Guarino, Al Ghaz & Winkel	Zea mays	Yafaa	Lahej	4
16078	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16079	Guarino, Al Ghaz &	Sorghum bicolor	Yafaa	Lahej	4

16080	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16081	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16082	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16083	Guarino, Al Ghaz & Winkel	Carthamus tinctorius	Yafaa	Lahej	4
16084	Guarino, Al Ghaz & Winkel	Lablab purpureus	Yafaa	Lahej	4
16085	Guarino, Al Ghaz & Winkel	Vigna unguiculata	Yafaa	Lahej	4
16086	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16087	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16088	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16089	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16090	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16091	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16092	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16093	Guarino, Al Ghaz & Winkel	Pennisetum glaucum	Yafaa	Lahej	4
16094	Guarino, Al Ghaz & Winkel	Triticum aestivum	Yafaa	Lahej	4
16095	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Yafaa	Lahej	4
16096	Guarino, Al Ghaz & Winkel	Triticum aestivum	Yafaa	Lahej	4
16097	Guarino, Al Ghaz & Winkel	Triticum aestivum	Yafaa	Lahej	4
16098	Guarino, Al Ghaz & Winkel	Triticum aestivum	Yafaa	Lahej	4
16099	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Wadi Watan	Lahej	3
16100	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Wadi Watan	Lahej	3
16101	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Wadi Watan	Lahej	3
16102	Guarino, Al Ghaz & Winkel	Pennisetum glaucum	Wadi Watan	Lahej	3
16103	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Wadi Watan	Lahej	3
16104	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Wadi Watan	Lahej	3
16105	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Radfan	Lahej	3
16106	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Radfan	Lahej	3

Collections in P.D.R. Yemen - 1988, 1989a & 1989b

No.	Collectors	Species	Variety
16019	Guarino & Balaidi	Abelmoschus esculentus	
16035	Guarino & Balaidi	Abelmoschus esculentus	
1229	Guarino & Al Ghaz	Abelmoschus esculentus	
1231	Guarino & Al Ghaz	Abelmoschus esculentus	
12042	Guarino, Obadi & Miller	Acacia aff. oerfota	
12014	Guarino, Obadi & Miller	Acacia edgeworthii	
12041	Guarino, Obadi & Miller	Acacia edgeworthii	
12002	Guarino, Obadi & Miller	Acacia hamulosa	
16002	Guarino & Balaidi	Acacia sp.	
16003	Guarino & Balaidi	Acacia sp.	
16001	Guarino & Balaidi	Acacia tortilis	
12039	Guarino, Obadi & Miller	Acacia tortilis?	
1190	Guarino & Al Ghaz	Allium cepa	
1207	Guarino & Al Ghaz	Allium cepa	
1203	Guarino & Al Ghaz	Allium cepa	
1219	Guarino & Al Ghaz	Allium cepa	
1223	Guarino & Al Ghaz	Allium cepa	
1232	Guarino & Al Ghaz	Allium cepa	
16073	Guarino, Al Ghaz & Winkel	Allium sativum	
16040	Guarino & Balaidi	Alysicarpus	
12001	Guarino, Obadi & Miller	Alysicarpus glumaceus	
16013	Guarino & Balaidi	Alysicarpus sp.	
1230	Guarino & Al Ghaz	Amaranthus sp.	
16012	Guarino & Balaidi	Anogeissus dhofarica	
16022	Guarino & Balaidi	Anogeissus dhofarica	
16045	Guarino & Balaidi	Anogeissus dhofarica	
12031	Guarino, Obadi & Miller	Arthrocarpum gracile	
16048	Guarino & Balaidi	Avicennia	
12037	Guarino, Obadi & Miller	Begonia socotrana	
16026	Guarino & Balaidi	Boswellia sacra	
1108	Guarino & Al Ghaz	Brassica nigra	
1250	Guarino & Al Ghaz	Brassica nigra	
1235	Guarino & Al Ghaz	Capsicum annuum	
16031	Guarino & Balaidi	Caralluma sp	
16083	Guarino, Al Ghaz & Winkel	Carthamus tinctorius	
16028	Guarino & Balaidi	Cenchrus pennisetiformis	
12021	Guarino, Obadi & Miller	Cenchrus pennisetiformis	
16024	Guarino & Balaidi	Cenchrus setigerus	

16029	Guarino & Balaidi	Cenchrus setigerus	
12036	Guarino, Obadi & Miller	Citrus aurantium	
12011	Guarino, Obadi & Miller	Corchorus erodioides	
1179	Guarino & Al Ghaz	Coriandrum sativum	
1194	Guarino & Al Ghaz	Coriandrum sativum	
16015	Guarino & Balaidi	Cucumis sativus	
16057	Guarino & Balaidi	Cucumis sativus	
1228	Guarino & Al Ghaz	Cucurbita sp.	
12025	Guarino, Obadi & Miller	Cylista schweinfurthii	
12043	Guarino, Obadi & Miller	Dactyloctenium aegyptium	
16039	Guarino & Balaidi	Dactyloctenium aristatum	
12013	Guarino, Obadi & Miller	Dactyloctenium aristatum	
12022	Guarino, Obadi & Miller	Dactyloctenium aristatum	
16025	Guarino & Balaidi	Dactyloctenium scindicum	
16027	Guarino & Balaidi	Dactyloctenium scindicum	
16041	Guarino & Balaidi	Dactyloctenium scindicum	
1054	Guarino & Al Ghaz	Dactyloctenium scindicum	
1089	Guarino & Al Ghaz	Dactyloctenium scindicum	
12015	Guarino, Obadi & Miller	Dactyloctenium sp.	
12020	Guarino, Obadi & Miller	Dactyloctenium sp.	
12024	Guarino, Obadi & Miller	Dactyloctenium sp.	
12040	Guarino, Obadi & Miller	Dendrosicyos socotranus	
1136	Guarino & Al Ghaz	Dolichos lablab	
12009	Guarino, Obadi & Miller	Eleusine coracana	
12028	Guarino, Obadi & Miller	Eleusine coracana	
1146	Guarino & Al Ghaz	Eleusine coracana	
1220	Guarino & Al Ghaz	Eleusine coracana	
12007	Guarino, Obadi & Miller	Eragrostis teff	
1212	Guarino & Al Ghaz	Eragrostis teff	
12044	Guarino, Obadi & Miller	Exacum affine	
1107	Guarino & Al Ghaz	Gossypium sp.	
16030	Guarino & Balaidi	Gossypium stocksii	
12023	Guarino, Obadi & Miller	Gramineae	
12034	Guarino, Obadi & Miller	Heteropogon contortus	
16075	Guarino, Al Ghaz & Winkel	Hordeum vulgare	
1110	Guarino & Al Ghaz	Hordeum vulgare	
16068	Guarino, Al Ghaz &	Hordeum vulgare	2-row

1071	Guarino & Al Ghaz	Hordeum vulgare	2-row
1073	Guarino & Al Ghaz	Hordeum vulgare	2-row
1079	Guarino & Al Ghaz	Hordeum vulgare	2-row
1081	Guarino & Al Ghaz	Hordeum vulgare	2-row
1109	Guarino & Al Ghaz	Hordeum vulgare	2-row
1255	Guarino & Al Ghaz	Hordeum vulgare	2-row
12027	Guarino, Obadi & Miller	Indigofera pseudointricata	
16064	Guarino, Al Ghaz & Winkel	Lablab purpureus	
16084	Guarino, Al Ghaz & Winkel	Lablab purpureus	
16036	Guarino & Balaidi	Legume H52	
16067	Guarino, Al Ghaz & Winkel	Lens culinaris	
16074	Guarino, Al Ghaz & Winkel	Lens culinaris	
12033	Guarino, Obadi & Miller	Lotus ononopsis	
1209	Guarino & Al Ghaz	Luffa sp.	
1227	Guarino & Al Ghaz	Luffa sp.	
16037	Guarino & Balaidi	Luffa H53	
1222	Guarino & Al Ghaz	Lycopersicon esculentum	
16016	Guarino & Balaidi	Malvaceae	
12019	Guarino, Obadi & Miller	Medicago laciniata	
16054	Guarino & Balaidi	Medicago sativa	
16072	Guarino, Al Ghaz & Winkel	Medicago sativa	
1080	Guarino & Al Ghaz	Medicago sativa	
1144	Guarino & Al Ghaz	Medicago sativa	
1168	Guarino & Al Ghaz	Medicago sativa	
1165	Guarino & Al Ghaz	Medicago sativa	
1180	Guarino & Al Ghaz	Medicago sativa	
1187	Guarino & Al Ghaz	Medicago sativa	
1192	Guarino & Al Ghaz	Medicago sativa	
1195	Guarino & Al Ghaz	Medicago sativa	
1210	Guarino & Al Ghaz	Medicago sativa	
1201	Guarino & Al Ghaz	Medicago sativa	
1205	Guarino & Al Ghaz	Medicago sativa	
1217	Guarino & Al Ghaz	Medicago sativa	
1218	Guarino & Al Ghaz	Medicago sativa	
1221	Guarino & Al Ghaz	Medicago sativa	
1236a	Guarino & Al Ghaz	Medicago sativa	
1233	Guarino & Al Ghaz	Medicago sativa	
1199	Guarino & Al Ghaz	Nicotiana tabacum	Sowaheli
12029	Guarino, Obadi & Miller	Ormocarpum caeruleum	
12026	Guarino, Obadi & Miller	Ormocarpum sp. nov.	
16057a	Guarino, Al Ghaz & Winkel	Pennisetum glaucum	
16058	Guarino, Al Ghaz & Winkel	Pennisetum glaucum	

16071	Guarino, Al Ghaz & Winkel	Pennisetum glaucum	
16093	Guarino, Al Ghaz & Winkel	Pennisetum glaucum	
16102	Guarino, Al Ghaz & Winkel	Pennisetum glaucum	
12010	Guarino, Obadi & Miller	Pennisetum glaucum	
1005	Guarino & Al Ghaz	Pennisetum glaucum	
1015	Guarino & Al Ghaz	Pennisetum glaucum	
1017	Guarino & Al Ghaz	Pennisetum glaucum	
1019	Guarino & Al Ghaz	Pennisetum glaucum	
1022	Guarino & Al Ghaz	Pennisetum glaucum	
1026	Guarino & Al Ghaz	Pennisetum glaucum	
1031	Guarino & Al Ghaz	Pennisetum glaucum	
1033	Guarino & Al Ghaz	Pennisetum glaucum	
1039	Guarino & Al Ghaz	Pennisetum glaucum	
1049	Guarino & Al Ghaz	Pennisetum glaucum	
1060	Guarino & Al Ghaz	Pennisetum glaucum	
1065	Guarino & Al Ghaz	Pennisetum glaucum	
1066	Guarino & Al Ghaz	Pennisetum glaucum	
1082	Guarino & Al Ghaz	Pennisetum glaucum	
1084	Guarino & Al Ghaz	Pennisetum glaucum	
1086	Guarino & Al Ghaz	Pennisetum glaucum	
1090	Guarino & Al Ghaz	Pennisetum glaucum	
1092	Guarino & Al Ghaz	Pennisetum glaucum	
1095	Guarino & Al Ghaz	Pennisetum glaucum	
1099	Guarino & Al Ghaz	Pennisetum glaucum	
1100	Guarino & Al Ghaz	Pennisetum glaucum	
1103	Guarino & Al Ghaz	Pennisetum glaucum	
1112	Guarino & Al Ghaz	Pennisetum glaucum	
1125	Guarino & Al Ghaz	Pennisetum glaucum	
1128	Guarino & Al Ghaz	Pennisetum glaucum	
1197	Guarino & Al Ghaz	Pennisetum glaucum	
1206	Guarino & Al Ghaz	Pennisetum glaucum	
1204	Guarino & Al Ghaz	Pennisetum glaucum	
1214	Guarino & Al Ghaz	Pennisetum glaucum	
1225	Guarino & Al Ghaz	Pennisetum glaucum	
1238	Guarino & Al Ghaz	Pennisetum glaucum	
1243	Guarino & Al Ghaz	Pennisetum glaucum	
1272	Guarino & Al Ghaz	Pennisetum glaucum	
16004	Guarino & Balaidi	Pennisetum sp.	Museibli
16005	Guarino & Balaidi	Pennisetum sp.	Museibli
16008	Guarino & Balaidi	Pennisetum sp.	Museibli
16033	Guarino & Balaidi	Pennisetum sp.	Museibli
16055	Guarino & Balaidi	Pennisetum sp.	Museibli
16057	Guarino & Balaidi	Pennisetum sp.	Museibli
1248	Guarino & Al Ghaz	Phaseolus sp.	
12030	Guarino, Obadi & Miller	Punica proropunica	
12017	Guarino, Obadi & Miller	Punica protopunica	
12018	Guarino, Obadi & Miller	Punica protopunica	

12035	Guarino, Obadi & Miller	Punica protopunica	
12038	Guarino, Obadi & Miller	Punica protopunica	
1145	Guarino & Al Ghaz	Raphanus sativus	
1196	Guarino & Al Ghaz	Raphanus sativus	
1215	Guarino & Al Ghaz	Raphanus sativus	
1226	Guarino & Al Ghaz	Raphanus sativus	
1234	Guarino & Al Ghaz	Raphanus sativus	
16038	Guarino & Balaidi	Rhynchosia	
16047	Guarino & Balaidi	Rhynchosia	
16032	Guarino & Balaidi	Rhynchosia sp.	
16053	Guarino & Balaidi	Sesamum indicum	
12008	Guarino, Obadi & Miller	Sesamum indicum	
1004	Guarino & Al Ghaz	Sesamum indicum	
1009	Guarino & Al Ghaz	Sesamum indicum	
1021	Guarino & Al Ghaz	Sesamum indicum	
1023	Guarino & Al Ghaz	Sesamum indicum	
1105	Guarino & Al Ghaz	Sesamum indicum	
1124	Guarino & Al Ghaz	Sesamum indicum	
1127	Guarino & Al Ghaz	Sesamum indicum	
1186	Guarino & Al Ghaz	Sesamum indicum	
1193	Guarino & Al Ghaz	Sesamum indicum	
1213	Guarino & Al Ghaz	Sesamum indicum	
1010	Guarino & Al Ghaz	Sesamum indicum	Local
1011	Guarino & Al Ghaz	Sesamum indicum	Mixture
1059	Guarino & Al Ghaz	Sesamum indicum	White
1115	Guarino & Al Ghaz	Setaria italica	Sael
16006	Guarino & Balaidi	Sorghum bicolor	
16007	Guarino & Balaidi	Sorghum bicolor	
16011	Guarino & Balaidi	Sorghum bicolor	
16014	Guarino & Balaidi	Sorghum bicolor	
16017	Guarino & Balaidi	Sorghum bicolor	
16034	Guarino & Balaidi	Sorghum bicolor	
16044	Guarino & Balaidi	Sorghum bicolor	
16046	Guarino & Balaidi	Sorghum bicolor	
16059	Guarino, Al Ghaz & Winkel	Sorghum bicolor	
16065	Guarino, Al Ghaz & Winkel	Sorghum bicolor	
16076	Guarino, Al Ghaz & Winkel	Sorghum bicolor	
12006	Guarino, Obadi & Miller	Sorghum bicolor	
1008	Guarino & Al Ghaz	Sorghum bicolor	
1012	Guarino & Al Ghaz	Sorghum bicolor	
1018	Guarino & Al Ghaz	Sorghum bicolor	
1139	Guarino & Al Ghaz	Sorghum bicolor	
1141	Guarino & Al Ghaz	Sorghum bicolor	
1143	Guarino & Al Ghaz	Sorghum bicolor	
1148	Guarino & Al Ghaz	Sorghum bicolor	
1150	Guarino & Al Ghaz	Sorghum bicolor	
1167	Guarino & Al Ghaz	Sorghum bicolor	

1156	Guarino & Al Ghaz	Sorghum bicolor	
1174	Guarino & Al Ghaz	Sorghum bicolor	
1175	Guarino & Al Ghaz	Sorghum bicolor	
1191	Guarino & Al Ghaz	Sorghum bicolor	
1211	Guarino & Al Ghaz	Sorghum bicolor	
1159	Guarino & Al Ghaz	Sorghum bicolor	Abu Ali
1176	Guarino & Al Ghaz	Sorghum bicolor	Abu Ali
1178	Guarino & Al Ghaz	Sorghum bicolor	Abu Ali
1189	Guarino & Al Ghaz	Sorghum bicolor	Ba-Quair
1135	Guarino & Al Ghaz	Sorghum bicolor	Ba-Quair (Ba-Hamar)
1131	Guarino & Al Ghaz	Sorghum bicolor	Barut
1132	Guarino & Al Ghaz	Sorghum bicolor	Barut
16049	Guarino & Balaidi	Sorghum bicolor	Bateim
16050	Guarino & Balaidi	Sorghum bicolor	Bateim
1029	Guarino & Al Ghaz	Sorghum bicolor	Beini
1032	Guarino & Al Ghaz	Sorghum bicolor	Beini
1034	Guarino & Al Ghaz	Sorghum bicolor	Beini
1036	Guarino & Al Ghaz	Sorghum bicolor	Beini
1042	Guarino & Al Ghaz	Sorghum bicolor	Beini
1047	Guarino & Al Ghaz	Sorghum bicolor	Beini
1048	Guarino & Al Ghaz	Sorghum bicolor	Beini
1123	Guarino & Al Ghaz	Sorghum bicolor	Beini
1126	Guarino & Al Ghaz	Sorghum bicolor	Beini
1216	Guarino & Al Ghaz	Sorghum bicolor	Beini
1267	Guarino & Al Ghaz	Sorghum bicolor	Beini
1003	Guarino & Al Ghaz	Sorghum bicolor	Beini?
1024	Guarino & Al Ghaz	Sorghum bicolor	Beini?
1025	Guarino & Al Ghaz	Sorghum bicolor	Beini?
1027	Guarino & Al Ghaz	Sorghum bicolor	Beini?
1154	Guarino & Al Ghaz	Sorghum bicolor	Buri
1162	Guarino & Al Ghaz	Sorghum bicolor	Buri
1163	Guarino & Al Ghaz	Sorghum bicolor	Buri
1067	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1072	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1074	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1077	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1093	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1098	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1102	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1104	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1111	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1118	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1119	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1122	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1241	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1242	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1244	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1245	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1247	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1252	Guarino & Al Ghaz	Sorghum bicolor	Dhurra
1117	Guarino & Al Ghaz	Sorghum bicolor	Dhurra red
1120	Guarino & Al Ghaz	Sorghum bicolor	Dhurra red
1236	Guarino & Al Ghaz	Sorghum bicolor	Erab
1239	Guarino & Al Ghaz	Sorghum bicolor	Erab

1246	Guarino & Al Ghaz	Sorghum bicolor	Erab
16009	Guarino & Balaidi	Sorghum bicolor	Erba
16062	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Gaidi
16078	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Gaidi
16080	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Gaidi
16089	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Gaidi
16061	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Garaba
16081	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Garaba red
16091	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Garaba red
16099	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Garaba red
16103	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Garaba red
16105	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Garaba red
16082	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Garaba white
16090	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Garaba white
16100	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Garaba white
16101	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Garaba white
16106	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Garaba white
16095	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Gedhar
1121	Guarino & Al Ghaz	Sorghum bicolor	Ghorba
1129	Guarino & Al Ghaz	Sorghum bicolor	Ghorba
1257	Guarino & Al Ghaz	Sorghum bicolor	Ghorba
1261	Guarino & Al Ghaz	Sorghum bicolor	Ghorba
1264	Guarino & Al Ghaz	Sorghum bicolor	Ghorba
1269	Guarino & Al Ghaz	Sorghum bicolor	Ghorba
1271	Guarino & Al Ghaz	Sorghum bicolor	Ghorba
1256	Guarino & Al Ghaz	Sorghum bicolor	Ghorba?
1056	Guarino & Al Ghaz	Sorghum bicolor	Haimar
16088	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Karti
16086	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Misra
16087	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Misra
1166	Guarino & Al Ghaz	Sorghum bicolor	Musn
16079	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Obli
16092	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Obli

1158	Guarino & Al Ghaz	Sorghum bicolor	Rabab
1200	Guarino & Al Ghaz	Sorghum bicolor	Resi
1202	Guarino & Al Ghaz	Sorghum bicolor	Resi
1224	Guarino & Al Ghaz	Sorghum bicolor	Resi
1237a	Guarino & Al Ghaz	Sorghum bicolor	Resi
16060	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Saif
1094	Guarino & Al Ghaz	Sorghum bicolor	Saif
1096	Guarino & Al Ghaz	Sorghum bicolor	Saif
1101	Guarino & Al Ghaz	Sorghum bicolor	Saif
1106	Guarino & Al Ghaz	Sorghum bicolor	Saif
1114	Guarino & Al Ghaz	Sorghum bicolor	Saif
1258	Guarino & Al Ghaz	Sorghum bicolor	Saif
1259	Guarino & Al Ghaz	Sorghum bicolor	Saif
1260	Guarino & Al Ghaz	Sorghum bicolor	Saif
1263	Guarino & Al Ghaz	Sorghum bicolor	Saif
1268	Guarino & Al Ghaz	Sorghum bicolor	Saif
1270	Guarino & Al Ghaz	Sorghum bicolor	Saif
1266	Guarino & Al Ghaz	Sorghum bicolor	Saif?
1052	Guarino & Al Ghaz	Sorghum bicolor	Senaisela red
1057	Guarino & Al Ghaz	Sorghum bicolor	Senaisela red
1061	Guarino & Al Ghaz	Sorghum bicolor	Senaisela red
1050	Guarino & Al Ghaz	Sorghum bicolor	Senaisela white
1053	Guarino & Al Ghaz	Sorghum bicolor	Senaisela white
1055	Guarino & Al Ghaz	Sorghum bicolor	Senaisela white
1062	Guarino & Al Ghaz	Sorghum bicolor	Senaisela white
1069	Guarino & Al Ghaz	Sorghum bicolor	Senaisela white
1070	Guarino & Al Ghaz	Sorghum bicolor	Senaisela white
1058	Guarino & Al Ghaz	Sorghum bicolor	Senaisela white
1063	Guarino & Al Ghaz	Sorghum bicolor	Senaisela white
1064	Guarino & Al Ghaz	Sorghum bicolor	Senaisela white
1085	Guarino & Al Ghaz	Sorghum bicolor	Senaisela white
1088	Guarino & Al Ghaz	Sorghum bicolor	Senaisela white
1091	Guarino & Al Ghaz	Sorghum bicolor	Senaisela white
1237	Guarino & Al Ghaz	Sorghum bicolor	Senaisela white
16104	Guarino, Al Ghaz & Winkel	Sorghum bicolor	Seneisela white
1240	Guarino & Al Ghaz	Sorghum bicolor	Somi
1251	Guarino & Al Ghaz	Sorghum bicolor	Somi
1134	Guarino & Al Ghaz	Sorghum bicolor	Thegil
1028	Guarino & Al Ghaz	Sorghum bicolor	Zaar
1030	Guarino & Al Ghaz	Sorghum bicolor	Zaar
1035	Guarino & Al Ghaz	Sorghum bicolor	Zaar
1043	Guarino & Al Ghaz	Sorghum bicolor	Zaar
1046	Guarino & Al Ghaz	Sorghum bicolor	Zaar
16051	Guarino & Balaidi	Sorghum bicolor	from Hadramawt
16052	Guarino & Balaidi	Sorghum bicolor	from Hadramawt
1185	Guarino & Al Ghaz	Spice (Habba sauda)	
16043	Guarino & Balaidi	Taverniera	
12003	Guarino, Obadi & Miller	Taverniera sp. nov.	
12032	Guarino, Obadi & Miller	Tephrosia apollinea	
12016	Guarino, Obadi & Miller	Tephrosia sp.	

12012	Guarino, Obadi & Miller	Teramnus repens	
1181	Guarino & Al Ghaz	Trigonella foenum-graecum	
1253	Guarino & Al Ghaz	Trigonella foenum-graecum	
1147	Guarino & Al Ghaz	Triticum aestivum	Amturka
1152	Guarino & Al Ghaz	Triticum aestivum	Amturka
16098	Guarino, Al Ghaz & Winkel	Triticum aestivum	Arbi
1075	Guarino & Al Ghaz	Triticum aestivum	Arbi
1157	Guarino & Al Ghaz	Triticum aestivum	Aswad-alghashmour
1160	Guarino & Al Ghaz	Triticum aestivum	Aswad-alghashmour
1161	Guarino & Al Ghaz	Triticum aestivum	Aswad-alghashmour
1164	Guarino & Al Ghaz	Triticum aestivum	Aswad-alghashmour
1169	Guarino & Al Ghaz	Triticum aestivum	Ba-fatim
1151	Guarino & Al Ghaz	Triticum aestivum	Bagareifa
1177	Guarino & Al Ghaz	Triticum aestivum	Bagareifa
1182	Guarino & Al Ghaz	Triticum aestivum	Bagareifa
1130	Guarino & Al Ghaz	Triticum aestivum	Halba
1133	Guarino & Al Ghaz	Triticum aestivum	Halba
1140	Guarino & Al Ghaz	Triticum aestivum	Halba
1142	Guarino & Al Ghaz	Triticum aestivum	Halba
1155	Guarino & Al Ghaz	Triticum aestivum	Halba
1183	Guarino & Al Ghaz	Triticum aestivum	Halba-assout
1184	Guarino & Al Ghaz	Triticum aestivum	Halba-assout
1188	Guarino & Al Ghaz	Triticum aestivum	Halba-assout
1137	Guarino & Al Ghaz	Triticum aestivum	Halba?
1138	Guarino & Al Ghaz	Triticum aestivum	Halba?
1172	Guarino & Al Ghaz	Triticum aestivum	Hali
1173	Guarino & Al Ghaz	Triticum aestivum	Hali
16070	Guarino, Al Ghaz & Winkel	Triticum aestivum	Hargadi
16094	Guarino, Al Ghaz & Winkel	Triticum aestivum	Hargadi
16097	Guarino, Al Ghaz & Winkel	Triticum aestivum	Hargadi
1076	Guarino & Al Ghaz	Triticum aestivum	Hargadi
1149	Guarino & Al Ghaz	Triticum aestivum	Masidegan
1171	Guarino & Al Ghaz	Triticum aestivum	Masidegan
1113	Guarino & Al Ghaz	Triticum aestivum	Musane
1170	Guarino & Al Ghaz	Triticum aestivum	Radfan
16096	Guarino, Al Ghaz & Winkel	Triticum aestivum	Samra
1097	Guarino & Al Ghaz	Triticum aestivum	Sonalika
16021	Guarino & Balaidi	Vatovaea pseudolablab	
16035a	Guarino & Balaidi	Vatovaea pseudolablab	
1198	Guarino & Al Ghaz	Vegetable (Rejlah)	
1208	Guarino & Al Ghaz	Vegetable (Rejlah)	
12005	Guarino, Obadi & Miller	Vigna radiata	
1001	Guarino & Al Ghaz	Vigna radiata	
1007	Guarino & Al Ghaz	Vigna radiata	
1014	Guarino & Al Ghaz	Vigna radiata	
1038	Guarino & Al Ghaz	Vigna radiata	
1041	Guarino & Al Ghaz	Vigna radiata	

1045	Guarino & Al Ghaz	Vigna radiata	
16020	Guarino & Balaidi	Vigna radiata	sublobata
16010	Guarino & Balaidi	Vigna unguiculata	
16018	Guarino & Balaidi	Vigna unguiculata	
16042	Guarino & Balaidi	Vigna unguiculata	
16063	Guarino, Al Ghaz & Winkel	Vigna unguiculata	
16069	Guarino, Al Ghaz & Winkel	Vigna unguiculata	
16085	Guarino, Al Ghaz & Winkel	Vigna unguiculata	
12004	Guarino, Obadi & Miller	Vigna unguiculata	
1002	Guarino & Al Ghaz	Vigna unguiculata	
1006	Guarino & Al Ghaz	Vigna unguiculata	
1013	Guarino & Al Ghaz	Vigna unguiculata	
1016	Guarino & Al Ghaz	Vigna unguiculata	
1020	Guarino & Al Ghaz	Vigna unguiculata	
1037	Guarino & Al Ghaz	Vigna unguiculata	
1040	Guarino & Al Ghaz	Vigna unguiculata	
1044	Guarino & Al Ghaz	Vigna unguiculata	
1051	Guarino & Al Ghaz	Vigna unguiculata	
1068	Guarino & Al Ghaz	Vigna unguiculata	
1078	Guarino & Al Ghaz	Vigna unguiculata	
1083	Guarino & Al Ghaz	Vigna unguiculata	
1087	Guarino & Al Ghaz	Vigna unguiculata	
1116	Guarino & Al Ghaz	Vigna unguiculata	
1249	Guarino & Al Ghaz	Vigna unguiculata	
1265	Guarino & Al Ghaz	Vigna unguiculata	
16023	Guarino & Balaidi	Woody subshrub	
16066	Guarino, Al Ghaz & Winkel	Zea mays	
16077	Guarino, Al Ghaz & Winkel	Zea mays	
1254	Guarino & Al Ghaz	Zea mays	