JORDAN:

COUNTRY REPORT TO THE FAO INTERNATIONAL TECHNICAL CONFERENCE ON PLANT GENETIC RESOURCES

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Note by FAO

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CHAPTER 1
Introduction

Jordan is a small country (8.92 million hectare). It is located in the eastern Mediterranean between latitudes 29° 30' and 32° 31'. The climate of Jordan is a Mediterranean, characterized by dry hot summer and mild wet winter and extreme variability in rainfall within and among years.

Temperature in Jordan varies from one region to another. Aqaba and Jordan valley regions are very similar in their temperature regime to subtropical climate; these are hot in summer and warm in winter. The steppe and steppe desert regions have a continental climate with a large amplitudes of temperature. The climate in the high lands of Jordan is characterized by a mild summer and a cold winter. Topography of the land is the main factor controlling the spatial distribution of temperature.

Rainfall is expected between November and March. The annual rainfall averages 30-100 mm in the steppe desert and exceed 800 mm in some areas in the high lands, with large variability between and within the regions. Snowfall is rare and conferred, generally, to high elevations (e.g. Shoubak and Ajlun mountains). Rainfall decreases considerably from west to east and from north to south (Abandah, 1978). Map 1. The total area can be divided into the following agro-ecological zones according to precipitation (Table 1).

Table 1 Agroecological zones with annual precipitation (MOA,1974).

Agroecological Zone	Annual ppt* (mm)	Area/Mil. hec.	Area (%)	Land Use
Arid	< 200	8.028	90	Range, Irrigated Cereal & Forage
Marginal Zone	200-300	0.56196	6.3	Wheat & Barley
Semi arid	300-500	0.1338	1.5	Wheat, Barley & Food Legumes
Semi humid	500-800	0.09812	1.1	Fruit Trees
Jordan valley	200-350	0.09812	1.1	Vegetables, Fruit Trees, Irrigated Cereal
Total		**8.92**	**100**	

*** : Annual precipitation.**
Source: Ministry of Agriculture, 1974

There are two main wind regimes affecting Jordan: these are the north west flow during summer and the south west east flow during the rest of the year

(Dept. of Metrology, 1970). Relative humidity varies largely from season to another and during the day. This variation depends on the region and the nature of soil cover. Relative humidity is low during summer. It is about 50% in high lands while it drops to about 30% in the steppe. Maximum values of more than 75% were recorded in the high lands during winter and values of 40-45% in the steppe (J.N.G.C.,1984).

The total number of population in 1992 is 4 million capita, of which 1.6 million capita live in Amman. The labor force in Jordan is 72% mainly in the service sector, 7% are working in the Agricultural sector, 11% working in the industry and 10% are working in the construction. Most of people are found in Marginal and Arid Zones with a percentage of 72%, Whereas, 28% are found in semi humid and semi arid areas.

Farming system in Jordan is mainly dependent upon water availability. The average area under rainfed agriculture in Jordan during 1980-1991 is 0.23 million hectare, 0.14 million hectare is planted with winter crops (wheat, barley, lentils, broad beans and forages). The area planted with summer crops is 8.1 thousand hectare (chickpeas, sesame, corn, and tobacco) and 8.1 thousand hectare is planted with vegetables (tomato, eggplant, squash, cucumber, cabbage, onions, potatoes, watermelon, lettuce, spinach, okra, and others) whereas, 70.7 thousand hectare is planted with fruit trees.(NCARTT, Strategy, 1994.). Table 2, shows yield of different crops in Jordan. Production is not enough for the country. The average export for the country over 12 years is 55849 Thousand JD whereas, the average imports is 251146 thousand JD as shown in Table 3 and Table 14 in appendix.

Table 2 Average Yield of Crops in Jordan during 1981-1983

CROPS	Yield (Ton/ha)
Winter field crops	00.834
Summer field crops	00.575
Tobacco	00.700
Total field crops & Tobacco	00.821
Summer rainfed vegetables	05.193
Summer irrigated vegetables	31.237
Winter irrigated vegetables	21.327
Total vegetables	23.364
Olives	01.142
Citrus	25.551
Others	5.838
Total orchards	**4.850**

Source: (Ramadan and Tair, 1993)

Table 3 Average imports and exports of food and live animals from 1981-1990

Product	Exports/ Thousand (JD)	Imports/ Thousand (JD)
Live Animals	5,292	14,195
Dairy Product & Eggs	8,041	21,645
Wheat & Flour of Wheat	1,210	39,134
Fruit, nuts & Vegetables	33,385	27,280
Others	7,921	148,892
Total	**55,849**	**251,146**

Source:(Ramadan and Tair, 1993)

Only 5% of the country's land area is arable; rainfed agriculture occupies some 450,000 ha; irrigated agriculture is estimated to cover 26,000 ha in the Jordan Valley and 35,000 ha (estimated ranging widely between 32,000 and 38,600 ha) in the Highlands. Live stock contributes an estimated 45% towards AGDP, and particularly sheep and goat numbers are believed to have sharply increased over the past 10-15 years, to an estimated total small-ruminant herd of 3.8 million head (70% sheep and 30% goats) of the estimated 8 million ha of rangelands, some 1.1 million ha are in the 100-200 mm rainfall zone, 1 million in the 50-100 mm and 5.9 million ha in the less than 50 mm rainfall zone. Water is the obvious major limiting factor for all economic activities.

Of the country's approximately 100,000 farmers and livestock producers, some 20,000 are irrigated farmers. The following categories of primary producers may be distinguished:

Irrigated Crop Production	20,134	farmers
Jordan Valley	(9,100	farmers)
Highlands	(11,000	farmers)
Rainfed Crop Production	33,000	farmers
Rainfed Mixed Farming	26,000	farmers
Livestock Production	20,840	producers
Total	**99,974**	**farmers**

Rainfed farming is characterized by small farm size and land fragmentation which have adversely affected the technical and economic feasibility of using modern inputs and services in the rainfed areas.

The Jordan cooperative Cereal Improvement projects (1984) conducted a number of field experiments and demonstration over five growing season for wheat in order to develop a package of practices appropriate to different agroclimatological Zones in Jordan. Results of these studies indicated that

early seeding (before rain), was better than that of the late seeding. Early seeding can result in poor stand establishment if early seed-ling growth occurs. It was recommended to place the seeds at depth of 6-8 cm to ensure that only heavy rains will germinate the seeds. Also, Al-Rujoub 1983, reported similar results for barley.

For lentils and chickpeas, farmers usually plant wheat crops first, then the lentils after the first few rains, and the germination of winter weeds to ensure weed free seed bed (Haddad,1983). Most farmers plant lentils during the period from late December to early February), sowing is done by hand ranging from 50-200 Kg/ha (Haddad and Arabiat, 1985).

Chickpeas are usually planted during the spring season to escape Ascochyta blight which occurs during winter planting but early planting in December with the availability of Ascochyta blight resistant varieties of chickpeas gave higher grain yield than that planted in February or March. (Jaradat, 1988). The total area of forests is only 80,0 thousand hectare or less than 1% of the total area of Jordan. These forests can be divided according to plantation into:

A - Natural forests: Most of these are governmental and totals 36,5 thousand hectares which include:

1. Broad leaved forests (ever green) occupy an estimated area of 21,0 thousand hectare, and include the following species; *Juncus, Pistacia palaestina*, *Ceratonia siliqua, Arbutus andrachne.*
2. Broad leaved forests (deciduous) occupy an estimated area of 4,5 thousand hectare and includ mainlythree species; *Quercus infectoria, Pistacia palaestina, Ceratonia siliqua.*
3. Coniferous forests which occupy 7,9 thousand hectare. The main species in this group are; *Pinus halepensis,* and *Juniperos.*
4. Mixed forests which occupy 3,0 thousand hectare in the north and have the following species; *Pistacia, Prunus* and *Quercus,* and *Pinus* species.
5. Olive forests located at Ajlun and occupy an area of 0.1 thousand hectare.

B - Artificial forests: The area covered by this group is estimated to be 40,0 thousand hectare.

In General most of the forest trees in Jordan are under severe pressure and threatened by genetic erosion, therefore intensive work regarding forest trees plantation in Jordan is needed (Kaleel. 1994).

CHAPTER 2
Indigenous Plant Genetic Resources

Variation in climate and topography in Jordan has led to a wide diversity in ecological habitat and flora. Flora of Jordan comprises approximately 2500 species ecologically and genetically adapted to local conditions. Most of these species are even adapted to the dryer parts such as the desert of Jordan. Therefore, the species growing in this vast area are of extreme importance as the primary vegetation element and hence their uses as edible for human, grazing for animals, medicinal, soil fixing, nitrogen fixing, parent of cultivated, disease, drought and saline resistant, important ornamental plants such as *Iris, Tulip, Allium, Crocus, Colchicum* and others. Therefore, it is a great advantage to have many species adapted to our environment and growing in such limited area. Lots of our local plants can be considered as an important national genetic resource which can be used for the future welfare of our people and mankind in general.

The country has a four distinct biogeographical regions:

- Mediterranean
- Irano-turanian
- Saharo-Arabian (Badia) and
- Sudanian (Tropical penetration) (Map 1).

The presence of four regions in a small country is very unusual whereas, the total number of vascular plant species in Jordan belong to about 730 genera and 122 families which is a great wealth in terms for national and international mankind (Al-Eisawi, 1994).

2.1 FOREST GENETIC RESOURCES

There are four major types of forest in Jordan :

1. Pine forests.

2. Evergreen oak forests.

3. Deciduous oak forests.

4. Juniperus forests.

2.1.1 Pine forests

Typical Mediterranean vegetation forms the best forest in Jordan and reaches a climax in some places, with the dominant tree *Pinus halepenses* up to 10 meters. This forest vegetation usually occurs on high altitudes mostly over 700 m. and where *rendzina* and calcareous soils are present. In some places the pine trees are replaced by *Quercus calliprinos* as a result of degradation of primary vegetation. Location Ajlun, Along the road between sakib and Jarash, Dibbeen and, Zie and Salt district.

***Stratum* 1.** The highest tree: *Pinus halepensis.*

***Stratum* 2.** The low trees and shrubs: *Pistacia palaestina, Quercus calliprinos, Arbutus andrachne.*

***Stratum* 3.** Low shrubs and bushes: *Calycotome villosa, Cistus villosus, Cistus salvifolius, Smilax aspera* and others.

***Stratum* 4.** *Herbaceous*: *Fumana arabica, Helianthemum lavandulaefolium, Thesium bergeri.*

Most of the *orchids* occur under such forest, for example: *Ophrys spp. Cephalanthera longifolia, limodorum abortivum, Orchis anatolica.*

2.1.2 Evergreen oak forests

This comprises the major part of the forest vegetation in Jordan and occurs in the north and south. This type of vegetation grows at high altitudes of more than 700m. and on *Terra Rosa* soil of hard limestone parental rock.

This is the vegetation which is being affected the most by human impact through the reduction of forest into agriculture land, and through the cutting of trees for heating and coal production. Vast areas in Jordan shows the remnants of such forests in the new growth of shoots from lower parts of the Trunks and roots.

The vegetation composition of this type varies through the leading species including the evergreen *Quercus calliprinos* which is the most important element. Although this vegetation is called evergreen, many of its components are deciduous like *Pistacia palaestina, Pyrus syriaca* and *Crataegus azarolus.*

Localities are near Amman up to Irbid in the north. It also occurs in the south in Tafila and Between Shobak and Petra.

The stratum in well preserved forest:

***Stratum* 1.** *Quercus calliprinos, Pistacia atlantica, Crataegus azarolus, Ceratonia seliqua, Pistacia palaestina, Arbutus andrachne, Styrax officinalis and Olea europaea.*

***Stratum* 2.** Low shrubs and climbers: *Amygdalus communis, Asparagus aphyllus, Lonicera obtusa, Rhamnus palaestinus, Rubia olivieri, Calycotome villosa, Cistus villosus, Sarcopoterium spinosum,* and *Lonicera obtusa.*

***Stratum* 3.** *Herbaceous: Anemone coronaria, linum pubescens, Adonis Palaestina, Poa bulbosa* and others.

2.1.3 Deciduous oak forests

The deciduous oak forests in Jordan occurs at a lower altitude than all other forests and mostly grow on red or brown soil of hard limestone parental rock. Most of these types of forest are not well protected, therefore they are subject to degradation.

The deciduous oak forests are found at a lower borders of the evergreen oak forests and they mix together for a limited area until they become pure stands of each type alone. Localities are Yarmuk river, Ishtafaina forest in Ajlun, Al Aluk near Jarash,and near king Talal Dam West Amman.

Composition: Three *strata,* not always clear, can be found with the following leading species.

***Stratum* 1.** Trees: *Quercus ithaburensis, Ceratonia siliqua, Styrax officinalis,* and *Pistacia palaestina.*

***Stratum* 2.** Shrubs: *Crataegus azarolus Amygdalus spp. Rhumnus palaestinus, Olea europaea, Calycotome Villosa, Retama raetam.*

***Stratum* 3.** *Herbaceous bushes: Dactylis glomerata, Urginea maritima,Carlina corymbosa, Sarcopoterium spinosum, Euphorbia hierosolymitana, Salvia sp., Tulipa sp.,* and *Colchicum sp..*

2.1.4 *Juniperus* forests.

This occurs in the southern part of Jordan, usually at high altitudes, over 1,000 m. and on sandy rocks. Unfortunately *Juniperus* forest are the least protected in Jordan, except in a very limited area at Tafila where only 40 old trees of *Cupressus sempervirens* remain.

Localities

Only two *strata* can be recognized because the heavy grazing and the degradation of the vegetation.

***Stratum* 1.** Trees and Shrubs: *Juniprus phoenica, Cupressus sempervirens, Pistacia atlantica, Rhamnus palaestinus, Daphne linearifolia, Thymelaea hirsuta, Colutea istria* and *Crataegus azarolus.*

***Stratum* 2.** Bushes and *herbaceous*: *Globularia arabica, Helianthemum vesicarium, Noaea mucronata, Achillea santolina, Onobrychis crista-galli* and others.

The importance of these forests, is that they have forest tree species growing under Jordan local specific environment. Some forest in Jordan are well isolated from similar forest of the same species by hundred or thousand kilometers such as *Juniperus Phoenica* in the southern part of Jordan which occurs on rocks of Kurnub and stone which does not hold water.

The seed center at Forestry Department is actively involved in collection and conservation of local forest seeds. Re-forestation of local varieties has been the most successful since local varieties are the most adaptable to environment conditions. Table 4 shows production of seedlings since 1989.

Many of the imported species that had been planted in the country died after severe frosts; examples of these species are *Acacia cyanophylla* planted at Ajlun area in the north, and *Atriplex numularea* (Australian variety) when planted at Fujieje range reserve and other range reserves were not able to reproduce naturally and all of this is due to non adaptability of imported varieties.

The species indicated in Appendix Table 15. is stored at seed center at Forestry department with a range of 1-100 kg. the seedlings production of the listed species undertaken by the forestry department were distributed to farmers or planted in the target areas. The capacity of seedling production since 1989 has been presented in Table 4.

The country still has about hundred trees of wild *Cupressus sempervirens* of more than one thousand years old. These few isolated trees have a unique genetic makeup which are highly advantageous for the country natural resources.

The presence of *Pinus halepensis, Quercus coccifera, Q. ithaburensis, Pistacia palaestina, Pistacia atlantica, Ceratonia siliqua, Pyrus sp., Crataegus spp., Cupressus sempervirens* and others, is very significant as the best species to be selected for our national program of re-forestation (Al Eisawi, 1985 and '94).

Table 4 Number of forest seedlings produced by Forestry Nurseries and the distributed seedlings since1989 in million.

Year	Seedlings Produced	Distributed Seedlings			
	(Million)	Forestry projects	Range	NGO *	Total distributed
1989	7.20	1.40	1.20	1.50	4.10
1990	6.50	1.10	1.40	1.60	4.10
1991	6.65	1.50	1.20	1.40	4.10
1992	7.00	1.53	1.15	1.70	4.38
1993	7.00	1.35	1.20	1.75	4.30

Source: Khaleel, 1994

*** NGO : Non governmental organization.**

2.2 WILD SPECIES AND WILD RELATIVES OF CROP PLANTS

Wheat, barley, lentils, and Chickpeas are the main field crops in Jordan. Keeping in view the genetic variability of these crops, several collection missions had collected these species from Jordan. A bout 485 species belonging to 330 genera and 99 families was recorded by Oran and Al Eisawi, 1994. The medicinal plants identified are either herbs, shrubs, or trees. Medicinal plant are distributed all over the country. With a wide range of distribution from the eastern desert or other parts of the country, those plants are massively used by Bedouins or local people, in folk medicine as hot or cold drinks, or chewed raw materials as fresh or dry. Also these are used externally to cure dermal diseases, either viral or bacterial infections, insects or animal bites or burns and some times for the treatments of the hair problems.

The following are examples of medicinal plants which are used in our daily life:

- *Acanthus syriacus* : Leaves and roots are used as emollient.
- *Ixiolirion tataricum:* Bulbs are used for skin diseases.
- *Narcissus tazetta*: Fresh bulbs are used as cataplasm for burns and to avoid suppuration.
- *Matrecaria aurea* : Flowers are used for stomach and abdominal pains.
- *Pistacia atlantica* (a tree occurs in the north and south of Jordan): leaves used as antidiabetic, against constipation and chest catarrh.
- *Rhus coriaria*: flowering buds and fruits are used as astringent, anti inflammatory and antiseptic, also used in burns and ulcers.
- *Calotropis procera:* Root bark is used for skin diseases, stomach ailments; leaves as vermifuge, and flowers for cough.

The examples mentioned above are used for special treatments and their uses are some times restricted except for *Matrecaria.*

Many plants are under collection pressure and used often for many purposes; some examples are: *Artemisia, Achillea, Salvia, Paronychia, Ecballium, Ephedra, Ajuga, Marrubium, Origanum, Alcea, Thymus, Sarcopoterium, Hyoscyamus* and many others.

The latex of *Euphorbia* species occurring in Jordan proved to be very efficient in the viral dermal infections, the warts for example, but this juice is very poisonous if taken orally or put on sensitive part, it may cause irritation.

These are a subject of extinction mainly because of man activity in the wild either by collecting these plants for his domestic use,grazing or housing and industrial projects established in the areas which are known of their beauty and richness of flora. The Projects which depend mainly on wild plants especially medicinal plant in order to be packed and marketed, and many of these plants are endemic like *Iris petrana, Cousinia dayia*, *Plantago maris-mortui*, *Crucianella transjordanica*, *Scrophularia nabataeorum, Silene hussonii* and *Tamarix arvensis* rare species are as followes; *Colchicum Tunicatum*, *Euclidium Syriacum, Lathyrus gloeospermus, Brunnera orientalis, Heterocaryum szovitsianum, Onosma roussaei, Campanula heirosolymitana, Legousia falcata, Silene hussonii, Chardinia orientalis, Centaurea procurrens, Cnicus benedictus, Convolvulus schimperi* (New to Jordan) *Aethionema carneum, Matthiola arabica, Cupressus sempervirens, Equisetum ramosissimum, Aegilops bicornis, A. cylindrica, A. ovata, A. searsii, A. distachyos, Asthenatherum forsskalii, Cutandia maritima and C. philistaea* (both New to Jordan) *Festuca arundinaceae, Hyparrhenia hirta, Pinnisetum asperifolium, P. ciliare, P. divisum Taeniatherum crinitum, Tetrapogon villosus, Ajuga iva, Teucrium leucocladum, Astragalus annularis, A.sanctus, Hippocripis bicontorta, Midicago litoralis, Tetragonolobus requienii, Trigonella maritima Plantago maris-mortui* or other species already undergoes extinction, are causing serious threats to wild habitat.

In terms of ornamental Plants, many wild plants in Jordan are used as ornamental. These are:

- Trees like: *Retama retaem Ceratonia siliqua*, and others or
- Bushes Like: *Astragalus, Cistus, Ceratonia, Salvia*, and *Ononis.*
- Bulbs like: *Tulip, Orchis,Iris,* and *Colchicum* etc. or
- Corm like: *Cyclamen* and *Scorzonera.*

Many local people and plant shop owner are affecting the bio diversity of these species since they pick them so as to be used as dry ornamental plants or in decoration directly.

Jordan has many species that need to be evaluated such as *Tetragonolobus*, a legume species that is both edible and fodder crop, high in protein content. Also, medicinal plants that are used in pop medicine needs to be evaluated.

Literature indicated that Jordan still harbor a vast diversity in forms of land races, old cultivars, wild forms and wild relatives of wheat and barley, such as Cultivated durum (*Triticum durum*) and bread (*Triticum aestivum*) wheat, wild wheat forms: *Triticum monoccocum, T. beoticum*, *T. turgidum*, *T. dicoccoides*, and Wild relatives of wheat, the Agilops spp., Cultivated two and six-row barley land races, old and improved cultivars (*Hordeum vulgare*), and the Wild barley, *Hordeum spontaneum*.

Diversity of wheat and barley is vulnerable to distinct out, threatened by agricultural intensification, urbanization and environmental pollution. Most of Jordanian farmers are using improved varieties of wheat (certified seeds which are selection of landraces that include Horani Nawawi, Horani27, F8, Safra Maan).

ACSAD 65, and Dairala 4) for barley most of farmers are still using local varieties 6-row and 2-row barley,others are using improved varieties e.g. Dairala 106, ACSAD 176.

Old cultivars of wheat (Safra ma'an) are still used in southern part of the country, while in the northern part Horani nawawi is used. These old varieties are highly adapted to the areas of production.

Government is discouraging the use of such old varieties because they are less productive than improved ones. Local people are not committed to conserve old varieties, but now there are programs for conservation of plant genetic resources considering conserving land races and local varieties.

CHAPTER 3
In Situ Conservation

Establishment of range reserves in Jordan is the earliest indirect activity for conserving plant genetic resources in Jordan. These protection activities began in 1945 and considered an effective tool for conserving plant germplasm. The following natural reserves are directed by Royal Society for Conservation of Nature, which is a NGO.

- Shomari reserve for wild animals.
- Azraq oasis for marine animals.
- Zobia reserve for wild animals.
- Mujeb reserve for wild animals.
- Dana reserve for wild animals.
- Wadi rum for wild animals.

The following reserves are planned to be established in the near future for wild life and wild flora of Jordan.

- Burkua
- Wadi rajel
- Abu rukba
- Jarba
- Jabal Masada

All these reserves belong to wild life conservation, also they serve the purpose of the wild and the weedy species of cultivated plants.

Range reserves were established with the objective of studying the botanical composition, productivity and effect of conservation on biodiversity in general. Table 5 shows the range reserves in the country, year of establishment, total area and annual rainfall.

Table 5 Natural Reserves, Year of establishment, total area and annual rainfall.

Reserve	Year of establishment	Location/ Governorate	Area/hectare	Rainfall(mm)
Kanasri	1964	Mafraq	454.5	180-220
Sura	1946	Mafraq	396.1	180
Sabha	1979	Mafraq	1,053.9	150
Daba	1968	Amman	300.0	120
Wadi butom	1986	Zarqa	150.0	80
Mujib	1981	Kerek	1,000.0	150
Lajun	1981	Kerek	1,100.0	150
Nakel	1987	Kerek	900.0	180-200
Tawaneh	1981	Tafilah	2,000.0	150
Fujiej	1958	Maan	1,000.0	200
Manshiah	1968	Maan	300.0	150
Alaishiah	1983	Maan	2,000.0	100-120
Ras En Nakab	1986	Maan	120.0	120
Wadi Rajeb	1983	Ajlun	450.0	200
Eira	1986	Balqa	2,000.0	250-200
Adasiah	1983	Amman	2,000.0	200
Maeen	1983	Madaba	2,000.0	200
Azraq	1987	Azraq	30,000.0	70

Source: Auklah,1994

3.1 *EX SITU* COLLECTION

The country lacked storage facilities; no national gene bank was available, and most of collected material was preserved at international gene banks mainly at ICARDA. For forest species the country has a seed center established on July 20, 1992 in cooperation with GTZ, aiming to protect seeds of forest trees. This seed center has active collection conservation where seeds are stored in medium-term storage slightly above 5 Co from which samples are drawn for distribution, exchange, multiplication and evaluation. Recently the country has established a genetic resources unit at NCARTT/Jordan; four rooms each room is 35 cubic meter relative humidity is not controlled whereas, temperature is controlled with arrange of +20 to -30 Co. Facilities to establish a national gene bank for the country with long term storage and medium term storage was a project proposal formulated in cooperation with WANA/IPGRI needs to be funded.

A national committee for plant genetic resources has been formulated in cooperation with WANA/IPGRI. This committee will guide NCARTT

National Gene Bank in terms of activities related to collection, evaluation and conservation of plant genetic resources according to country needs.

3.2 DOCUMENTATION, EVALUATION AND CHARACTERIZATION IN REGARDS OF:

A) Plant Germplasm of Cereals

More than 10 collecting expeditions for cereal germplasm were organized in different parts of Jordan. Landraces and old cultivars of wheat and barley were collected. Detailed of that is given in Table 6. The collected material from Jordan has been well documented and evaluated for many traits. The evaluation indicated that Jordanian cereal germplasm provide a great breeding potential in yield and protein content improvement. IPGRI is working with the faculty of Agriculture at the University of Jordan to evaluate the wild wheat which is stored at Aleppo site. Furthermore ICARDA has supported research work at the Faculty of Agriculture to evaluate the durum and bread wheat for their genetic variability, purity and disease resistance.

Table 6 Cereal germplasm collection missions conducted in Jordan 1952-1992

Mission	Year	Species	No. Acc.	No. Loc.	Reference
1	1952-1957	*Triticum Turgidum durum* (old cultivars/*LR)*	71	10	Damania et al 1991
2	1978	*Triticum* sp.	33	2	Jana S., 1982
		Aegilops sp.			
		Hordeum spontaneum			
		Avena sterilis			
3	1981	*Triticum durum (LR)*		6	Witcombe J.R,1983
		Hordeum vulgare (LR)	60		Jana S., 1982
		2R + 6R			Weltzien E., 1989
4	1981	*Hordeum vulgare (LR)*	37		
		2R + 6R			Witcombe et al 1982
		Hordeum spontaneum	38	10	Witcombe J.R. 1983
		Aegilops species	59		
5	1984	*Triticum durum (LR)*	>132	10	Jaradat 1991(a)
					Jaradat 1991(b)
					Damania et al 1991
6	1984	*Triticum durum (LR)*			Jaradat et al 1987(a)
		Triticum dicoccoides			Jaradat et al 1987(b)
		Triticum aestivum		10	
		cultivated	>76		
		Hordeum vulgare (LR)			
		2R + 6R, cultivated			
		Hordeum spontaneum			

Mission	Year	Species	No. Acc.	No. Loc.	Reference
6	1984	*Aegilops* species			
7	1986	*Hordeum Vulgare*	9		Jaradat A.A 1989
		Hordeum spontaneum	9	9	
8	1987-1988	*T. turgidum durum(LR)*	12		Van Slageren et al, 1990
		T. dicoccoides	45		Jaradat & Humeid 1990
		T. beoticum	10		Jaradat 1991c
		Aegilops species	101	9	Jaradat 1991b
		H. vulgare distichon	2		
		Hordum spontaneum	12		
9	1991	*T. turgidum durum (LR)*	7		Humeid and Harman 1991
		cultivated	12		
		T. aestivum (LR) cultivated	4		
		Aegilops species	41		
		Hordeum vulgare distichon	13	103	
		Hordum vulgare	92		
		hexastichon			
		Hordum spontaneum			
10	1992	*Triticum dicoccoides*	5		Humeid et al 1992
		Triticum beoticum	2	12	
		Triticum aestivum	5		
		Total	**887**	**181**	

Source: Khairallah,1994

Tahir and Valkoun (1994) mentioned that there were 1,255 cereal accessions from Jordan Kept at ICARDA as of December 1993. The distribution of these accessions is as follows:

Table 7 Number of Cereal accessions Kept at ICARDA, 1994

Crops	No. of accessions
Barley	134
Wild Barley	127
Durum Wheat	270
Bread Wheat	17
Other Cultivated Wheat	1
Wild Wheat	508
Aegilops	198
Total	***1,255***

3.3 GERMPLASM CHARACTERIZATION AND EVALUATION

The collected cereal germplasm from Jordan has been evaluated by Jaradat (1991 a, b and 1992). ICARDA, has performed an extensively large-scale evaluation for wheat germplasm stock, held by its gene bank. Most of the Jordanian wheat material were evaluated for 25 economically important characters, Jordanian land races were represented in all desirable and useful traits and their different associations (Table 8). ICARDA's evaluation was referred to identification number (ID) of each accession. Thus, ICARDA's evaluation data is most available and accessible to breeders and interested cereal specialists.

Evaluation of Wild Wheat: From the two wild wheat *T. dicoeccum* and *T. dicoccoides* found in Jordan, *T. dicoccoides* gained most attention. *T. dicoccoides* (wild emmer) is well known as the immediate progenitor for modern cultivated wheat (Zohary, 1970). *T. dicoccoides* was explored recently in Jordan (Jaradat and Jana 1987, Jaradat et al, 1988) and evaluated for many traits. Jaradat and Humeid (1990) studied 42 accessions from 10 locations in Jordan for 7 qualitative and 6 quantitative traits, and Jaradat (1993) studied the same material for 17 traits, including resistance to Yellow Rust. They (Jaradat and Humeid 1990, and Jaradat 1993) found a wide range of diversity spread over a wide range of altitude (-200 to 1500 m) characterized by two morphologically different races and a number of different intermediate race types. The early heading genotypes with short filling period of *T. dicoccoides* indicated (Jaradat and Humeid 1990) indirectly that some genotype of *T. dicoccoides* are drought tolerant and/or of higher photosynthetic capability than the check varieties used, 54% of *T. dicoccoides* accession originated from Jordan were found Rust resistant.

ICARDA-GRU evaluations on *T. dicoccoides* confirmed resistance to drought and diseases of Septoria blotch, common bunt, yellow rust, stem rust and Barley Yellow Dwarf Virus. Protein content of *T. dicoccoides* was found to be higher than cultivated wheat varieties ranging from 13%-27%. *T. dicoccoides* collected from Jordan was subjected to a comprehensive evaluation study. The results indicated that accessions of *T. dicoeocum* represent an important genetic characters such as; earliness, short stem, high number of fertile tillers, long spikes, kernel weight per spike, protein content and drought tolerance.

Table 8 Wheat Land races from Jordan as represented in Economically desirable traits groups

Economically Desirable Traits	No. acc.
Early-heading at two locations	(2)
Early-maturity at two locations	(3)
Grain-filling period: A. Short, intermediate, long grain filling, high grain yield	(14)
B. Short, intermediate, long grain filling, high agronomic score	(26)
High agronomic score at Breda	(31)
High agronomic score at Breda with high yield at Tel Hadya	(23)

Economically Desirable Traits	No. acc.
Resistance to yellow rust	(7)
Resistance to common bunt	(5)
Combined resistance to yellow rust and common bunt	(1)
High 1,000 kernel weight	(3)
Combination of good grain quality traits (high 1,000 KW, high protein content, vitreousness) and high grain yield	(1)
Combination of traits for drought tolerance, early, maturity, high filling, tall plant, high agronomic score and high grain yield	(1)

Source: Khairallah,1994.

B) Genetic resources of food legumes in Jordan

Germplasm of food legumes mainly lens, chickpeas and their wild relatives were collected from Jordan and the seeds were conserved at ICARDA.

Table 9 Food legume species and number of accession conserved at ICARDA GRU

Crop	No. of Accessions
Chickpeas	143
Wild Cicer	8
Lentils	373
Wild lentils	12
Faba bean	23
Total	***559***

Source Nanish,1994

Evaluation of these material with other accessions from Syria, Iraq Lebanon, Tunisia and Libya were carried out. In comparison to ICARDA's total

germplasm collection, Jordanian lentil were the earliest in flowering and maturity and produced the highest biological and seed yield. Lentil varieties has been released or pre release by national programs in Jordan and above mentioned countries.

Jordanian chickpea accessions which were jointly evaluated by ICARDA and Jordanian research institutes were susceptible to cold, Aschochyta, and leaf minor. Utilization of chickpeas germplasm in Jordan is limited therefore; more collection missions and evaluation regarding chickpeas, fababean and other food legumes are still needed (Nanish,1994).

C) Plant Genetic resources of forage legumes and range plants in Jordan

Forage production in Jordan is limited in both quality and quantity and livestock sector is in shortage of feed especially, in winter when forage production is scarce.

Pasture and forage legumes were introduced to farming systems in which forage legumes are grown in rotation with cereals, with fallow or continuous cereal system. Studies of NCARTT with ACSAD and through the Mashreq project indicated that Medic or Vetches in rotation with cereal has resulted in significant increases in total productivity. Nitrogen level in soil was increased.

To explore native pasture and forage with potential to improve livestock feed, a collection mission was under taken by NCARTT in 1989 and 1990. In collaboration with ICARDA, 113 sites at different parts of the country were covered. The total number of accession collected were 1,774 in addition to herbarium, nodules with Rhizobia and soil samples (NCARTT, 1990,1992). Evaluation of all accessions is carried out at ICARDA, only few accessions are held at NCARTT and this is mainly due to lack of facilities and staff.

The contribution of the natural vegetation is limited due to poor yield of range lands. Vegetation production of range lands in Jordan has been estimated as shown in the following table

Table 10 Range areas with total estimate yield of natural vegetation

Range area	Rain fall (mm)	Area(ha)/ (000ha)	Production (Kg/ha)	Total Ton(Dwt)
Desert	100	7,100	40	284
Steppe	100-200	1,000	100	100
Mountainous	>200	45	300	13.5
Forest	>200	40	300	12
Total		**8,185**		**409.5**

Source: Tadros,1994

Productivity of Jordan natural vegetation lands could be improved by

- Establishment of protected natural range reserves.
- Reseeding natural reserves of locally adapted species.
- Proper management system.

Activities that were held regarding range genetic resources were of exploration type (survey and herbarium collections)and they were not fully documented. Studies and researches are still needed in this area.

D) Plant Genetic Resources of Fruit Trees

Wild genetic progenitors of fruits trees are found in Jordan in the upland from north to the south and east to west such as *Ceratonia siliqua, Ziziphus lotus, Ziziphus spina-christi, Caratagus aronia, Prunus mahaleb, Pistacia, Ficus and Olea*. These species and genera have adapted to harsh conditions which include extremes in temperature coupled with extended drought and low soil fertility. They are excellent resources for future research after identification of root stocks like dwarfism, draught and calcareous soil tolerance. Unfortunately little information is available regarding this field and a major interest in Jordan would be the use of a number of genera in the *Pomidaceae* as rootstocks, this includes the use of

A - Pome fruits

- Apple Malus spp. Malus tribolota.
- Local hawtharn. Crataegus azorolus.
- Wild Pear. Pyrus communis.
- Wild Quince. Cydonia oblonga.

B - Stone Fruits

- Local bitter almond. *Prunus amygdalus.*
- Wild almond. *Amygdalus arabicus.*

Pome and stone fruits production is mainly dependent on imported root stocks, which they are often unadapted to local environment, and require further investigation. *Prunus amygdalus* are local root stocks which are used in the country. The use of these local pome fruits as root stocks instead of the imported ones could increase fruit production. Also the use of *Crataegus azarolus* as a root stock for "Golden Delicious" and "Williams" pear had met success at Jordan University, while the wild local almond and *Amygdalus arabicus* is now under investigation (Qrunfleh, 1994).

CHAPTER 4
In-Country Use of Plant Genetic Resources

The wild genetic material collected from Jordan is mainly stored at gene banks outside the country. Very little material is being kept at the various institutions in Jordan including Ministry of Agriculture/NCARTT or universities. For cultivated species, NCARTT, the Ministry of Agriculture and the Jordan cooperative organization are involved into multiplying and distribution of certified seeds of cereals, food legumes and forages. Some farmers use their own seeds. The private sector is very active in supplying seeds to farmers. which includes imported hybrids seed of vegetable crops. Recently the commercial seed companies have started production of vegetable seed and limited quantities are available for distribution such as Onions, Cucumber, Tomato, Okra, Potatoes, and Beans.

For fruit trees, the MOA is providing the farmers with seedlings of mainly olive trees, grapes, pome and stone fruits. The private sector is also very active in the production of olives and grapes seedlings for both local and export purposes. The source of rootstock are local and imported material. Bitter almond, Pistachio, and hawthorn are extensively utilized as root stock. Jordan imports large quantities of fruit plants from up road.

Unfortunately, up to now the country has no field gene bank for fruit trees. Jordanian scientists mainly in the universities and MOA have been involved in germplasm collection and evaluation which concentrated mainly on the utilization of *Triticum dicoccoides* as a source of disease resistance and protein quality of Cereals. Land races, legumes, squash and Tomatoes were collected and characterized by NCARTT. Presently we can say that there are six cereal and vegetables breeders who have active role in this field.

The plant breeding programs in Jordan started with breeding for improvement of cereal varieties, so the breeder concentrated on enhanced germplasm introduced mainly from CIMMYT and ICARDA and other centers, and thus several wheat and barley varieties were released. Presently there are cereal breeding programs at the universities and NCARTT. Seed multiplication for onions, Okra, Mallow and broad bean is undertaken by MOA. Some trials were conducted by NCARTT to produce Lettuce, Cauliflower, Okra, broad bean, and onion seeds. A breeding program of lentils and chickpeas was initiated at UOJ during 1980-1990 and few varieties were released. The efforts were made to incorporate some genes from introduced wild tomatoes genotypes at university of Jordan. Recently the

research at Universities become active in production of potatoes seeds using tissue culture techniques.

Field crop breeding is being conducted by the public sector institutions with the objective of producing varieties which can tolerate the stress conditions mainly drought. The private sector is involved in production of hybrid tomato and cucumber seed. It is envisaged that potatoes seed production will involve both public and private sector. As mentioned earlier the efforts in the utilization of germplasm are scattered in different institutions and be duplicated in some cases. It is of vital importance that efforts should be coordinated and gene banks to be established. This requires the availability of human resources capable of running the various activities of such banks. The establishment of National coordinating committee on plant genetic resources of Jordan is an important step toward unifying the efforts needed in this respect.

It is hoped that IPGRI will take an active role in assisting the national program to equip and improve the country and with other international organization in this respect.

4.1 CROP IMPROVEMENT PROGRAMS AND SEED DISTRIBUTION

Certified Seed in Jordan for wheat barley, lentils and chickpeas is produced by Ministry of Agriculture, where Breeder seed are taken from NCARTT, ICARDA or any other International Center, multiplication of the breeder seed is carried out (Breeder seed, Basic seed, and then Certified seed) in cooperation with Jordan Cooperative Organization (JCO), certified seeds are then distributed to farmers with encouraging low prices.

In general this material is not enough for the whole farmers and varies from one season to another. Table 11. Shows the Average production for Certified seed from 1988-1993. This production covers only 30.3%, 29% of the total area suitable for wheat and barley Production, respectively. Private companies in the country Play a great role in supplying farmers of seed crops material supplied through these companies are under Ministry of Agriculture control.

Imported varieties have many disadvantages since they are not locally adapted to harsh conditions of Jordan, they suffer from drought pest and diseases.

Certified cereal seed production in Jordan started since 1952, By Ministry of Agriculture Through NCARTT and in cooperation with local International Institutes. From this program the following were produced.

- Wheat; F8, Horani 27, Horani Nawawi, Dair Ala (2,4,6,), Amra, Petra, jubeiha and Sham 1.
- Barley; Dair Ala 106, ACSAD 176, Rum, and from the promising varieties are; Hermil, Vin, Roth, and Gieza.
- Lentil; Adas Jordan 1,2,3.
- Chickpea; Jubiha chickpea 1,2,3.

Suggested Prices for Cereal seeds in Jordan are in Appendix.

Table 11 Seed production of Basic (Bas.) and Certified (Cer.) in Jordan during 1988 - 1993 in Ton.

Yr	Wheat		Barley		Lentil		Chickpea	
	Bas.	Cer.	Bas.	Cer.	Bas.	Cer.	Bas.	Cer.
88	168.5	2,312.5	194.4	261.1	-	-	-	-
89	154.1	1,388.1	44.3	344.7	-	-	-	-
90	204.8	3,107.3	91.5	587.6	-	-	-	-
91	44.8	2,924.0	77.2	1,432.0	12.6	38.0	3.9	31.0
92	304.2	3,638.4	148.2	2,198.9	22.1	31.5	17.0	31.4
93	396.6	3,155.9	146.4	1,534.3	13.0	17.8	12.8	37.8
Av	**212.2**	**2,754.4**	**117.0**	**993.1**	**15.9**	**11.3**	**11.3**	**33.4**

Source: Saleh et. al. 1993.

4.2 UTILIZATION OF CEREAL GERMPLASM

Wild emmer is used to improve Durum wheat grain quality and disease resistance. (Abu El Einin 1988, Mali et al 1993) used *T. dicoccoides* to asses the transfer of desirable gene to improve local cultivar "Horani" they evaluated the crosses on different progeny level (F2-F6) and found that improvement of protein content is possible without Losing yield Potential, but still Utilization is limited. Stress in terms of drought and heat is a major factor affecting the production of crops in Jordan. Therefore, the varieties and land races of crops in Jordan posses some traits which help to resist or tolerate these stresses. The Jordanian material has been used in many crosses by the international centers or by national programs. For example Safra Man (PI 283154) from Jordan was used in crosses by Clarke et. al 1994 to study the inheritance of glaucousness and epicuticular wax in Jordanian wheat.

CHAPTER 5
National Goals, Progress and Legislation

Jordan is working nowadays on preparation for a chatter on agricultural policy. It calls:

- For agriculture, animal husbandry, and forestry sector which is contributing the protection of the natural environment and to the preservation of natural resources by adapting land use patterns and technologies which are sustainable and in harmony with principles and requirements of the preservation of soils, water, flora and fauna.
- An agricultural, where scientific and technological progress is being adapted and utilized with responsibility to the present and future society and to the ecology.
- An agricultural economy, which provides opportunities and motivation for the coming young generations.
- An agricultural and animal husbandry orientation, which will uphold the culture, beauty of the Jordanian countryside.

It is clear that the available agricultural production resources, especially water, land and labor are managed and used with economic efficiency, which preserving the environment and ensuring the sustainability of agricultural production in the long term.

The GRU is an important unit in the structure of NCARTT which was approved by the council of NCARTT. Fig 1. in appendix, and appointment of the head of this unit is by the Minister of Agriculture upon the recommendation of Director General of NCARTT. The budget of this unit is hoped that it will attract fund from donor agencies because of vital role and the support of the National Committee which is comprised of members from different institution including the Ministry of planning.

It is hoped that the activity of GRU will replace the fragmented activity in the different institutions and will play a catalytic and coordination role.

5.1 NATIONAL PROGRAM

Recently Jordan established a genetic resources unit at NCARTT, through a project proposal supported by the technical Assistance office (TASO) United

State Agency for International Development (USAID). The Project budget was 43,100 JD for two years 1993-1995 the project was able to support the Unit with 2 staff members and some equipment. This Unit is working as a separate unit through NCARTT.

The objectives of this Unit are:

- Collection of plant genetic resources from Jordan
- Evaluation, Documentation and conservation of plant genetic resources in accordance with international rules
- Promote exchange of plant genetic resources material and information.

Collection missions are arranged according to country needs and species priorities using ICARDA manual for taking eco-biogeographical data, Descriptors of IPGRI are used for evaluation purposes, conservation of seed material is carried out at ICARDA gene bank. It is hoped that storage facilities will become operational at this unit in the near future. It is also very important to know that the 1994, NCARTT workshop recommended that this unit will be the National Center for plant genetic resources in Jordan.

The following collection mission were carried out in Jordan by NCARTT since 1989.

Table 12 Collection mission, Number of accessions, Total number of species and cooperating organization for plant genetic resources from 1989-1992 carried out by NCARTT

Year	Collection Mission	No. of. Acc.	No. of species	Cooperating organization
89	Forage legumes	685	62	ICARDA
90	Forage legumes	2,116	120	ICARDA
91	Wild barley, Wheat	196	7	ICARDA
92	*Triticum dicoccoides*	19	1	JUST, ICARDA
92	*Tetragonolobus, Lathyrus*	11	3	
Total		**3,027**	**139**	

Source: Syouf, 1994

Evaluation of plant genetic resources is carried out at ICARDA. Only few accessions are evaluated by NCARTT, this is mainly because lack of facilities and staff. Some of the accessions were also recently provided to the University of Jordan for evaluation. Table, 13 shows evaluated material at NCARTT during 1989-1994.

Table 13 Number of accessions of forage species evaluated at NCARTT during 1989-1994

Crops	Period	Location	No. of Acc.
Medic	89-90	Baqa'	276
Medic	92-93	Baqa'	37
Vicia	91-92	Ramtha	25
Vicia	93-94	Baqa'	36
Barley	91-92	Baqa'	5
Lathyrus & Tetragonolobus	93-94	Baqa'	3
Forage multiplication	93-94	Baqa'	300

Source: Syouf, 1994

The head of GRU is accountable to head of NCARTT. The position is secure and only ministry of agriculture is legally authorized to abolish the program. The annual budget of GRU is a part of the budget of NCARTT from where our share according to our need and it is a regular funding from government. There is no legislation regarding the Genetic resources of Jordan the germplasm is exchange on mutual bilateral sharing bases. Any how we are in the process of making legislation in consultation with ministry of low to meet the future need of germplasm.

The importance of germplasm could be well understood as the government has created anew GRU at NCARTT under MOA, to promote its utilization in collaboration with national commodity program for sustainable agricultural production.

Through 2-4 August 1994 this Unit held the first genetic resources workshop in Jordan in cooperation with WANA/IPGRI and TASO/USAID. Seventeen discussion papers were presented and more than 30 scientists from international and local institutions participated in the work shop.

This workshop resulted in:

- A comprehensive discussion regarding biodiversity and plant germplasm in Jordan in which submitted papers will be published by WANA/IPGRI in a proceeding.
- Formulation of local committee of plant genetic resources of Jordan. A national committee will be formulated through this committee, the structure of this committee will be as follows:
    - Head, Dr. M. Duwayri, University of Jordan

- Secretary, Head of GRU/NCARTT, M. Syouf
- Dr. D. al-Eisawi,JU
- Dr. A. Aukla, YU
- Dr. R. Shibli, JUST
- K. Aukla, Environment Department
- A member ship of Ministry of planning
- A member of WANA office/IPGRI

The workshop resulted in the following recommendations.

- Plant genetic resources of Jordan, being a part of the fertile Crescent, is a national and international heritage; these resources should be conserved and utilized for the benefit of humanity. In the past, individual efforts led to the collection, conserving, evaluation and utilization of a sizable part of these resources, however, these effort should be brought under one national umbrella in order to efficiently utilize the available resources.
- In order to encourage the national efforts in plant genetic resources work, a national committee should draw a short and a long term strategic plan for the sole purpose of safe guarding and utilizing these resources.
- Previous efforts in plant genetic resources work concentrated on cereals, pulses, forages and pasture crops. It is highly recommended that other genetic resources such as vegetables, fruit trees, forestry, medicinal and aromatic plants be given equal attention in the future. Moreover, International legislation should be adhered to when activities in plant genetic resources are planned in the country.
- The Genetic Resources Unit at NCARTT was assigned the responsibility of being the National Unit where plant genetic resources should be deposited and documented; these efforts have to be coordinated with other concerned departments around the country.
- Trained manpower in plant genetic resources is very limited in Jordan, therefore it is highly recommended that International Centers (e.g. IPGRI and ICARDA) should continue their efforts in training personnel from Jordan on different aspects of plant genetic resources work both for short and long term. Jordanian Universities are encouraged to include this subject in their teaching and research agenda.
- Documented information on plant genetic resources of Jordan should be available to users. A unified methodology for documentation should be agreed upon (e.g. IPGRI's or ICARDA's documentation system).

- A national directory of workers in plant genetic Resources should be compiled. It should include information on research interests and areas of expertise.

5.2 TRAINING

Presently we are four scientist in GRU keeping in mind the work load we need more scientists and support staff for smooth functioning of the activities. The national program is not adequately staffed with trained personnel. Training is needed regarding documentation, evaluation and conservation both for long and short term period and is expected to be also in the field of genebank management, taxonomy and biotechnology courses in Plant Genetic Resources are not targeted for the undergraduate or graduate studies. However there are few graduate students conducting their research in this area. The infrastructure and scattered human resources can be utilized with assistance from international center to start some action or short term courses. Just they do not have a proper theoretical background. It is therefor suggested that special attention should be paid for post graduate training of GRU-Jordan from University of Birmingham.

Training courses are equally important for both man and women as both are equally responsible for the conservation activities.

5.3 NATIONAL LEGISLATION

There is now a strong awareness of environment and pollution issues in Jordan. However it can be said that there is a limited awareness about the importance of plant genetic resources and a national efforts are needed in this respect. The Jordanian society is a fast learner in this respect and the establishment of the genetic resources unit and the national committee are going to play a major role in this respect.

The quarantine laws in Jordan are not very strict to affect the passage of genetic resources materials.

Jordan will be receiving germplasm mainly cereal nurseries from the international centers. Also the germplasm flow abroad was not checked.

It is hoped that the genetic resource unit and the MOA will play a great role in controlling the outflow of genetic resources on it.

The private sector in Jordan is active in vegetable seed import including almost all vegetable seeds.

The signing of the Intellectual property Rights is being discussed in Jordan. Furthermore the MOA has set up a committee to draft the regulation on vegetable seed production and handling in Jordan. It is supposed also to answer the question of Intellectual property rights and to plant breeder rights.

Jordan has a bilateral exchange of germplasm policy. The Director of NCARTT has the full power regarding the exchange of germplasm, these decision are made on recommendation of head of GRU. Presently the country has not signed any agreement with neighboring countries regarding the exchange of germplasm.

5.4 OTHER POLICIES

The seed production program in Jordan on cereals and production of certified seed is going well. However Jordan requires assistance (Bilateral) on variety release since lots of efforts is being spent on breeding new varieties Utilizing land races or introduced germplasm. However Jordan is not active in release of new varieties in this respect. As mentioned earlier, vegetable production program is going on with help of GTZ. Therefore a new breeding program should be designed taking in mind the production of land races, and genetic resources, their utilization in breeding varietal release, multiplication and distribution.

Jordan is preparing an agriculture policy for the country. It is planned that this policy will achieve efficiency, sustainability and equity.

Efficiency means

- Developing and making optimal use of the available natural and agricultural resources, and
- Applying the concepts of economic efficiency and competitive advantage in utilizing these resources.
- Sustainability means:
- Managing and conserving the natural resources for agricultural production such that these resources (especially soil and water resource) are saved or even in terms of quantity, where technically and economically feasible;
- That measures aiming at promotion of agricultural development must be achievable in the long run, and must not become a continuous burden to the government budget;

- Developing that legal and institutional framework to provide stability and continuity as well as a favorable investment environment agricultural development: and
- Assuring continuous food supplies to the consumers in adequate quantity and quality.

Equity means

- Achieving social and economic equity between agriculture and other economic equity between agriculture sector itself;
- Providing equal social and economic opportunities for all participants in the agrobusiness, especially those engaged in agriculture production, and in particular those who make their living on land they are cultivating;
- Increasing the incomes of farmers and agricultural workers to equitable levels, and improving their standards of living accordingly.

CHAPTER 6
International Agricultural Research Centers

Jordan has signed the United Nation Conference on Environment Development (UNCED) at Rio de Janeiro/Brazil during 1992 and has discussed agenda 21, Jordan has signed the agreement on biodiversity and climate change on 5th June 1992 and the Royal decree was issued on approving biodiversity agreement and climate change on Nov. 9th 1993. This will help Jordan in many aspects of biodiversity, plant genetic resources. The government of Jordan has formed a national committee interested with the activity for conservation of biological biodiversity. The Ministry of Agriculture, Ministry of Planning, Ministry of Tourism and Antiquities, the universities, the Royal society for Conservation of Nature, the society for Protection of Environment and the Department of Environment are all represented in the committee.

These have proposed to make a study which will cover the different aspects of biodiversity. The subjects suggested will include:

- Terrestrial biodiversity - Fauna (reptiles and amphibians, birds, mammals, invertebrates)
- Terrestrial biodiversity - Flora (botany, taxonomy, forestry microbiology)
- Marine and aquatic biodiversity-flora and fauna (plant, animals algae)
- Ecosystems (ecology, natural resources management, captive breeding, marine aquatic biology)
- Genetic resources (crop plants, domestic, animals, fisheries, forest resources, and tenure, biotechnology)
- Economics (environment-natural resources economics)
- Sociology (demography, socioeconomic)
- Sociology (demography, socioeconomy)
- Others (data/information analysis and management, legislation/institution ecotourism)
- Data acquisition and management, economics, preparation of media posters/brochures for awareness campaign.

Both the government of Jordan and UNDP have indicate their willingness to fund the above studies.

Jordan is emphasizing:

- establishment of system for reserves or areas which needs special precaution for conservation of biodiversity
- maintenance of deteriorated ecological systems to restore the natural habitat including the restoration of endangered species
- management of biological resources to conserve biodiversity in reserves or open fields
- encouragement of sustainable development which is environmentally sound
- definition of important elements of biodiversity and use it in a sustainable way
- protection of ecological system and natural resources and conservation of the habitats of species capable of persisting in nature.

Since the establishment of the International Board for plant genetic resources (IBPGR) in 1974. A first Southeast Asia conservation program started in 1976. It included six countries of the region.

Jordan and Lebanon joined the conservation efforts between 1981-1983, when the program was terminated because of political instability and wars in several cooperating countries (Ayad, 1986). IBPGR's. Objectives of the program were collection, conservation, evaluation and utilization of plant genetic resources and the promotion of the regional cooperation and linking of the national programs to the world wide net work of IBPGR resources centers. Between 1981-1983 Jordanian teams collected 400 accessions of crops and crop related species of which 344 were cereal 5 Vicia, 12 lens and 50 forage species. It was noticed that among cooperating countries Jordan was the only one without a genebank. With the establishment of a genetic resources unit at ICARDA during mid 1980's IBPGR delegated its responsibilities to ICARDA's mandate crops. Since then Jordanian and ICARDA scientists have jointly collected germplasm in Jordan. In 1992 Jordan signed the establishment agreement of International plant Genetic Resources Institute (IPGRI).

Jordan established a seed center for forest species in cooperation with GTZ in 1992, the main objective of this center was to conserve local forest species and make seeds available for reforestation. Jordan is cooperating with CIGAR centers mainly with CIMMYT and ICARDA for introduction of cereal and food legume crops. These centers have also provided training Jordanian scientists either in country or abroad.

CHAPTER 7

The activities on biodiversity have received some attention in Jordan in the past. There were scattered efforts by scientists in different scientific institutions in Jordan. Therefore the biodiversity of several important agricultural species have been studied fairly. Tremendous efforts are needed in the future to cover the following aspects.

- Extent of exploration to capture maximum agro biodiversity for future utilization. Survey of endangered species which include endemic, rare and the important species.
- Continue present efforts of exploration and collection mission of plant species covering the various ecological zones.
- Evaluation of the collected germplasm which includes field and lab evaluation. This requires strengthening some of the biochemical laboratories and Training in biotechnology and Taxonomy.
- Establishment of field genebanks, to cover the different regions of Jordan. These genebanks should include wild land races and present varieties of fruit trees.
- Development of human resources. Well trained specialized personnel are needed for the sustainability of these activities special attention is being given to the training of graduate students for master degrees at the agriculture. This activity should be strengthened and new Ph.D. program should be implemented in cooperation with International centers on foreign Universities. However scholarships to study abroad may still be needed. Therefore funds for graduate studies and equipment are needed.
- Assistance in publishing germplasm catalogues to maximize utilization of the collected material.
- Strengthen the genetic resources Unit to become the national genebank and national herbarium. Therefore glass houses laboratories and required equipment are needed. Staff of GRU should be expanded and should receive adequate training an expatriate may be needed at this point of time.
- Identification of sites where models for in situ conservation of an annual self pollinated crop relatives and methods of sampling and evaluation can be tested.

- Establishment of a living collection of deciduous fruit tree clones (apple, pear, quince, prune, apricots, almond, fig, pomegranate and grapes) rescued from old mixed orchards and vineyards that are on the region.

It was agreed during WANA NET meeting on October 4-7,1994 at Cyprus that Jordan will prepare a proposal for an in situ conservation. M. Ajluni from JUST University was named for preparation of this proposal.

CHAPTER 8
Proposal for a Global Plan of Action

The scattered efforts in the past by the scientist should be consolidated. A mechanism for germplasm collection, conservation evaluation, distribution and utilization should be developed. Research on storage should be encouraged.

Conservation of genetic resources require funds and technology, because developing countries generally lack these funds and the technology to protect these resources, funds should be made available from the rich countries Therefore, International cooperation is needed to advance the interest in the genetic resources to a high priority level since it is hard for a nation, troubled by food production problems and high national debt to have genetic resources on their high priority.

In the light of the weak infrastructure availability of funds, availability of trained human resources in many of developing nations, the international agriculture research centers should take a leading role in the biodiversity activities.

Human resources development. This is very essential for the maintenance of biodiversity activities. Higher education out side the developing countries is expensive and therefore unless scholarships are made available for people from these nations it would be difficult to build such base.

There wise the efforts in biodiversity may be done by individuals who have special need for germplasm and therefore these collection will be at serious risk degree programs can be started at national universities and training for higher degree can be obtained at selected universities in North America and Europe. Furthermore short term courses for technicians can be held at the international centers or regional institutes.

APPENDIX

Table 14 Suggested prices for Cereal Crops in Jordan During 1992-1994

Seed	Supply, selling (JD/Ton)	Demand, Baying (JD/Ton)	Consumption (JD/Ton)
Wheat	156	175	147
Barley	116	130	105
Lentil	316	320	300
Chickpea	316	390	350
Vicia	191	220	-

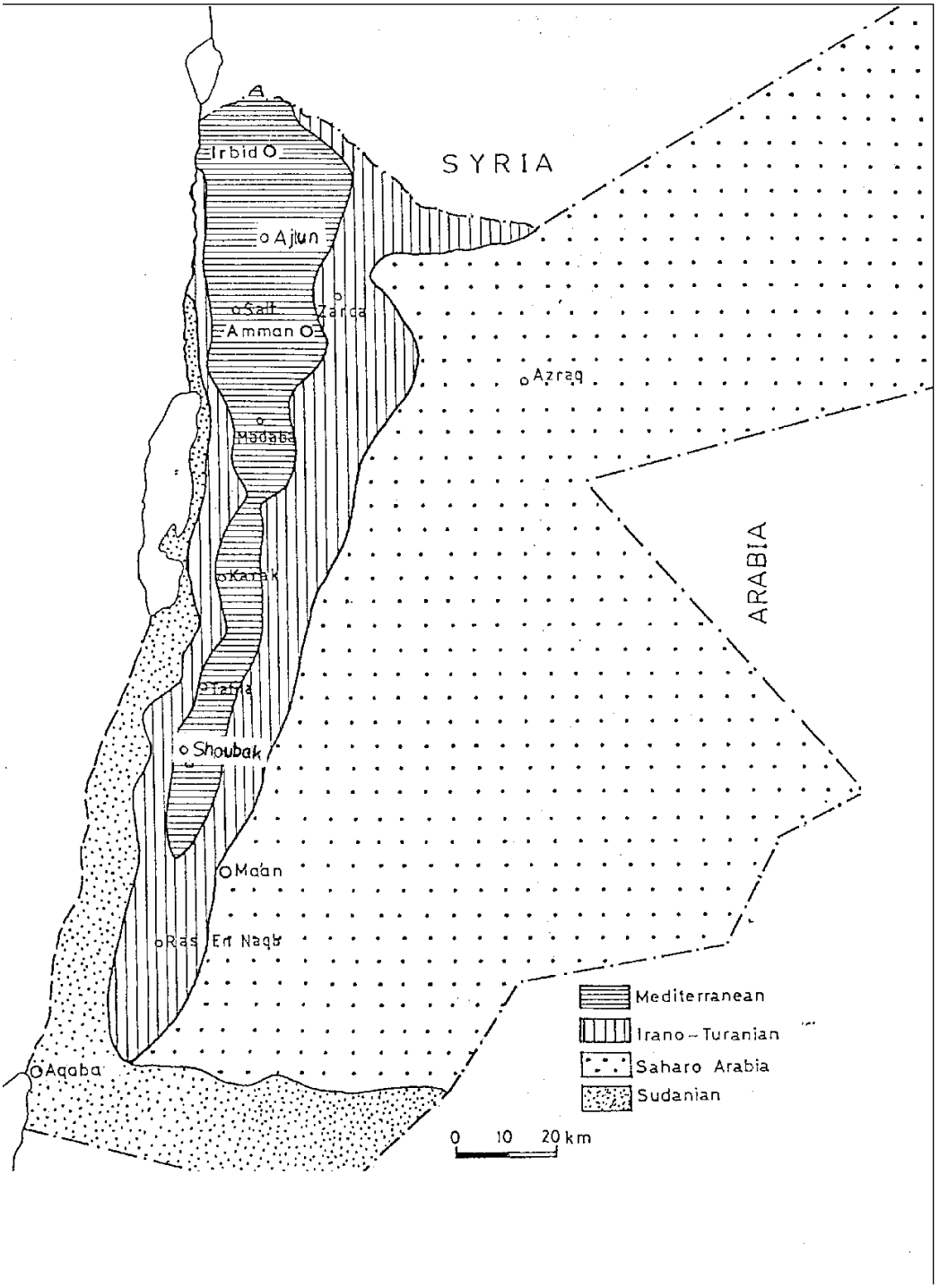
Table 15 Forest seed* species *at Forestry Department, Amman

No	Species
1	*Abies cilicia*
2	*Acacia arabica*
3	*acacia cyanophylla*
4	*Acacia farnesiana*
5	*Acacia horrida*
6	*Acacia raddiana*
7	*Acacia seyal*
8	*Ailanthus glandulosa*
9	*Albizzia lebbeck*
10	*Alnus orientalis*
11	*Amygdalus communis*
12	*Arbutus andrachne*
13	*Atriplex halimus*
14	*Atriplex numularia*
15	*Atriplex semibaccata*
16	*Bauhinia variegata*
17	*Bougainvillea spectabilis*
18	*Brachychiton populnea*
19	*Capparis officinalis*
20	*Castanea vesca*
21	*Casuarina cunninghamiana*
22	*Casuarina equisetifolia*
23	*Cedrus libani*
24	*Celtis australis*
25	*Ceratonia siliqua*
26	*Cercis siliquastrum*
27	*Colutea istria*
28	*Crataegus azarolus*

No	Species
29	*Cupressus arizonica*
30	*Cupressus macrocarpa*
31	*Cupressus sempervirens*
32	*Dalbergia sisso*
33	*Dodonea viscosa*
34	*Duranta plumieri*
35	*Elaeagnus officinalis*
36	*Eucalyptus brockwayii*
37	*E. camaldulensis*
38	*E. gomphocephala*
39	*Ficus carica*
40	*Ficus nitida*
41	*Glediysia triacanthos*
42	*Haloxylon spp.*
43	*Hibiscus syriacus*
44	*Jacaranda mimosifolia*
45	*Pistacia vera*
46	*Platanus orientalis*
47	*Ponclana regia*
48	*Populus alba*
49	*Populus euphratica*
50	*Populus nigra*
51	*Populus spp.*
52	*Poterium spinosum*
53	*Prosopis chilensis*
54	*Prosopis farcta*
55	*Prosopis juliflora*
56	*Prosopis spp.*
57	*Prosopis tamarugo*
58	*Prunus amygdalus*
59	*Prunnnus dulcis var. amora*
60	*Punica granatum*
61	*Pyrus amygdaliformis*
62	*Quercus aegilops*
63	*Quercus calliprinos*
64	*Quercus coccifera*
65	*Quercus infectoria*
66	*Quercus spp.*
67	*Juglauns regia*
68	*Juniperus phoenica*
69	*Juniperus scopulorum*
70	*Lantana camara*
71	*Laurus nobilis*

No	Species
72	*Ligustrum japonica*
73	*Melia azaderach*
74	*Moringa optera*
75	*Moringa peregrina*
76	*Morus nigra*
77	*Myrtus communis*
78	*Nerium oleander*
79	*Olea europaea*
80	*Parkinsonia aculeata*
81	*Phoenix dactylifera*
82	*Pinus brutia*
83	*Pinus canariensis*
84	*Pinus halepensis*
85	*Pinus nigra*
86	*Pinus pinea*
87	*Pistacia atlantica*
88	*Pistacia palaestina*
89	*Pistacia terebinthus*
90	*Retama retama*
91	*Rhamnus palestina*
92	*Rhizinus officinalis*
93	*Rhus carica*
94	*Rhus tripartita*
95	*Robinia pseudoacacia*
96	*Salix alba*
97	*Salix fragilis*
98	*Salix spp.*
99	*Salsola vermiculata*
100	*Salvadora persica*
101	*Schinus molle*
102	*Sesbania aegyptica*
103	*Simmondsia chinensis*
104	*Sophora japonica*
105	*Styrax officinalis*
106	*Tamarindus indica*
107	*Tamarix articulata*
108	*Tecoma capensis*
109	*Thuja oriantalis*
110	*Ulmus orientalis*
111	*Vitex* spp.
112	*Washingtonia filifera*
113	*Ziziphus spinachristi*

MAP 1 PLANT GEOGRAPHICAL REGIONS



References

Ababneh, M. (1994) Plant Genetic Resources Workshop. National Center for Agricultural Research and Technology Transfer (NCARTT). Baqa', Jordan.

Abandah, A. (1978) long-range for casting seasonal rainfall in Jordan. Department of Metrology, Publication No. JNWS/78/11 17 p.

Abu-El-Enein, J. (1988) Utilization of Wild Emmer (*Triticum turgidum*) var. *Dicoccoides* in Improving cultivated Durum Wheat. MSc thesis, Faculty of Graduate Studies, University of Jordan.

AlEisawi, D. (1985) Vegetation in Jordan in A. Hadidi Studies in History and Archaeology of Jordan Vol.ii.pp. 45-57. Dep. of Antiquities Amman, H.K.J.

Al- Eisawi, D. (1994) Plant Genetic Resources Workshop, August 2-4, 1994. National Center for Agricultural Research and Technology Transfer (NCARTT).Baqa', Jordan.

Al- Rujoub, F. A. (1983) Effect of sowing date and depth on performance of eight barley genotypes under rainfed conditions. A thesis submitted to the faculty of Agriculture, University of Jordan as a partial fulfillment for a degree of Master of science. 130 leaves.

Aukla, K. (1994) Plant genetic resources workshop, 1994. August 1-4,1994. NCARTT. Baqa', Jordan.

Ayad, W.G. (1986) Conservation of crop germplasm: an overview of the FAO/IBPGR regional programme for South-West Asia. Proc. Roy. Soc. Edinborrough, 89:265.

Damania AB, Pecetti L, Srivastava JP, Jana S, Porceddu E (1990) Evaluation and documentation of durum wheat germplasm; Report on selected accessions for economically useful traits. International Center for Agricultural Research in Dry Areas, Aleppo, Syria.

Damania AB, Valkoun J, Humeid BO, Pecetti L, Srivastava JP Porceddu E (1991) Durum wheat germplasm Catalog International Center for Agricultural Research in Dry Areas, Aleppo, Syria.

Department of metrology (1970) Climatic Atlas of Jordan.

Duwayri, M. (1979) Effect of sowing date on yield of wheat under rainfed conditions in Jordan. Dirasat. vol. 6. No. 2, p. 99-108, Amman, Jordan.

Grama A, Gerechter-Amitai ZK, Blum A (1983) Wild emmer as a donor of genes for resistance to stripe rust and for high protein content. Proc. 6th Int. Wheat Genetic Symp. 187-192.

Haddad, N. (1981) A chickpeas production and strategy for winter planting. workshop on Ascochyta Blight and winter sowing chickpea. May 4-7, 1981. ICARDA, Aleppo,Syria.

Haddad, N. and S. Arabiat.(1985) Methods and problems of planting lentils in Jordan. Dirasat. Vol. 12. No. 6 p. 31-74. Amman, Jordan (in Arabic).

Hakim S, Damania AB, Moualla MY (1991) Genetic variability in *Triticum dicocceum* Schubl. for use in breeding wheat for dry areas.

FAO/IBPGR Plant Genetic Resources Newsletter 88/89: 11-15.

Humeid B, Hamran M (1991) Collection of cereals in Jordan. Annual Report GRU-ICARDA, Aleppo, Syria.

Humeid B, Hamran M, Jaradat A, Thapsom Z (1992) Collection of wild wheat relatives in Jordan. Annual report GRU-ICARDA, Aleppo, Syria.

International Center for Agicultural Research in Dry Areas, annual report. 1987

Jana S (1982) CANADA-ICARDA collaboration for cereal germplasm conservation.

FAO/IBPGR Plant Genetic Resources Newsletter 49: 5-10.

Jaradat A, Jaradat T, Jana S, Srivastava JP (1987a) Diversity for quantitative characters in Jordanian landraces of barley. In Proceeding of the International Barley Genetic Symposium, Okayama 1986.

Jaradat AA, Jana S, Pietrzak LN (1987b) Collection and evaluation of cereal genetic resources of Turkey and Jordan. Rachis vol 6, No. 1: 12-14.

Jaradat.A. (1988) an Assessment of Research needs and priorities for rainfed agriculture in Jordan, pp. 415.

Jaradat AA (1989) Ecotypes and genetic divergence among sympatrically distributed populations of *Hordeum vulage* and *Hordeum spontaneum* from the xeric region of Jordan. Theor Appl. Genet. 78: 857-862.

Jaradat AA, Humeid BO (1990) Morphological variation in *Triticum dicocoides* from Jordan. In Wheat Genetic Resources: Meeting Diverse Needs. (ED) J.P. Srivastava and A.B. Damania ICARDA, (Pub.) John Wiley & Sons.

Jaradat AA (1991a) Levels of phenotypic variation for developmental traits in landraces genotypes of durum wheat (*Triticum turgidum* ssp. *Turgidum L. conv. durum*). Desf. MK from Jordan. Euphytica 51:265-271.

Jaradat AA (1991b) Phenotypic divergence for morphological and yield-related traits among landrace genotypes of durum wheat from Jordan. Euphytica 52: 155-164.

Jaradat AA (1991c) Grain protein variability among populations of wild barley (*Hordeum spontaneum* C. Koch.) from Jordan. Theor Appl. Genet. 83: 164-168.

Jaradat AA (1992a) Genetic diversity of four esterase loci in natural populations of (*Hordeum spontaneum* C. Koch.) from Jordan. Theor Appl. Genet. 84:725-729.

Jaradat AA (1992b) Estimate of phenotypic diversity and traits associations in durum wheat landraces from Jordan. J. Genet. & Breed. 46: 69-76.

Jaradat AA (1992c) Breeding potential of durum wheat landraces from Jordan II. Differential responses to drought. Hereditas 116: 305-309.

Jaradat AA (1993) Ecogeographical races in natural populations of *Triticum dicoccoides.* In biodiversity and wheat improvement (ED). Damania AB, ICARDA (PL) Wiley-Sayce.

John M. Clarke,Thomas N. McCaig, and Ronald M. Depauw. (1994) Crop Science. 34:327-330.

Jordan cooperation cereal project. (1984) A report on the Jordan cooperative cereal improvement project. University of Jordan, and in the dry area. Aleppo, Syria 49.p.

Jordan National Geographic Center (J.N.G.C.) (1984) National atlas of Jordan, Part 1. climate and agroclimatology Amman. 135 p.

Khairallah, K. (1994) Plant Genetic Resources Workshop. 1994, August. 1-4, 1994. NCARTT. Baqa' Jordan.

Khaleel. I. (1994) Plant Genetic Resources. August 1-4, 1994 Workshop, 1994. NCARTT. Baqa' Jordan.

Loizides, P. (1979) Crop rotation under rainfed conditions in Mediterranean climate in relation to soil moisture and fertilizer requirements. Rainfed Agr. in near east and north Africa. FAO, Rome, 1980. p.23-25.

Maali S.H, Dawaryi M, Nachit M M (1993) Utilization of *Triticum dicoccoides* in grain quality improvement of *T. turgidum L var. durum* (unpublished).

Mamlouk OF, Damania AB (1990) Evaluation of *T. dicoccum* and *T. dicoccoides* for disease resistance. Annual Report GRU-ICARDA, Aleppo, Syria.

Mamlouk OF, Ghoalam W (1991) Screening for barley yellow dwarf virus (BYDV) resistance in cereals. Annual Report GRU-ICARDA, Aleppo, Syria.

Nanish, N. (1994) Plant genetic resources workshop. August 1-4, 1994. NCARTT. Baqa', Jordan.

Qrunfleh, M. (1994) Plant Genetic Resources workshop. 1994. August 1-4, 1994. NCARTT, Baqa', Jordan.

Ramadan, N. and S. Abu Tair (1993) Agricultural Data. Ministry of Agriculture, Data bank Division. Dept. of Agricultural Policy and Economic.

Saleh, H. Katkhuda, N. Kateeb.F and others. (1993) Working paper. Cereal Production in Jordan. In Arabic.

Syouf, M. (1990) Plant genetic resources in Jordan. Report, NCARTT, Baqa', Jordan.

Syouf, M. (1992) Plant genetic resources in Jordan. Report, NCARTT. Baqa', Jordan.

Syouf, M. (1994) Plant genetic resources workshop. 1994. August 1-4, 1994, NCARTT. Baqa', Jordan.

Tadros, K. (1994) Plant Genetic Resources Workshop. August, 1-4, 1994. NCARTT. Baqa', Jordan.

Tahir, A. and J. Valkoun (1994) Wheat information service. 78: 1-12. ISSN 0510-3517.

Van Slageren M, Mamlouk OF (1991) Diversity for important wheat diseases in a selection of ICARDA *Aegilops* collection. Annual Report GRU-ICARDA, Aleppo, Syria.

Weltzien E (1989) Differentiation among barley landraces populations from Near East. Euphytica 43: 29-39.

Witcombe JR, Bourgois JJ, Rifaie R (1982) Germplasm collections from Syria and Jordan.

Witcombe JR (1983) A provisional world list of barley expeditions. FAO/IBPGR Plant Genetic Resources Newsletter 53: 25-40.

Zohary, D (1970) Centers of diversity and centers of origin. In: OH. Frankel & E. Bennett (Eds). Genetic Resources in plants; their exploration and conservation. P. 33-42 Blackwell, Oxford and Edinburgh.