# Research and Training Center For Plant Virus Control

# in Turkey

A Proposal

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# DEVELOPMENT of A RESEARCH AND TRAINING CENTER for PLANT VIROLOGY IN TURKEY

## Project Summary:

The Turkish agricultural economy and the associated research supporting this sector are in transition. Diversification of crops and development of new markets and new crops is a high priority. Emphasis is being placed on the production of several different fruit and vegetable crops. It is estimated that virus diseases cause up to 20% losses in these crops. The proposed research and training center will develop new and improved methods for detection, diagnosis and control of virus diseases that cause major losses in Turkish and that pose a threat to U.S. agriculture. The Center will be located in the Plant Protection Research Institute in the city of Adana on the Cukurova Plain. Laboratory space and professional and support staff will be supplied by the Turkish government.

Research at the Center

The U.S. and Turkey have had close cooperation in maintaining biodiversity and conserving native Turkish germplasm. For more than seventy years the USDA has collected native plant material in Turkey that has been used to increase yields and improve disease resistance in major U.S. food crops. It is essential to continue this relationship for the benefit of both countries. The proposed Center will provide a facility that will allow the evaluation of collected Turkish germplasm for resistance to virus diseases that occur in the Near East region.

Protecting the U.S. from the accidental or deliberate introduction of exotic non-indigenous viral pathogens is a high national priority. There is an urgent need to establish the new research center in Turkey to develop methods of early detection and diagnosis of these diseases and develop methods of control. The Center will provide U.S. scientists with a facility where they can conduct research on exotic viruses in collaboration with Turkish scientists.

Research at the Center will provide a critical step in establishing methods of control and provide technologies that will limit further spread of the diseases. Accomplishment of these goals will require a properly equipped laboratory with instrumentation for virus isolation, purification, and characterization. Research will include field studies on modes of transmission and the identification and control of virus vectors. The laboratory will also provide virus-free plant material. This is of great importance in the establishment of healthy perennial crop plantings that remain in orchard production for many years.

Culture of opium poppies in Turkey is strictly controlled by the national government. The introduction of new higher yielding poppy varieties is resulting in significant reductions in the areas under cultivation. It is estimated that the number of licensed



poppy fields will decline from 12,000 to 8,000 hectares. Nearly 100,000 farm families and members directly or indirectly depend on the poppy crop at support price levels. As a result, there is an urgent need for farmers to establish alternative cropping practices and transition to other crops that will support farm families. Research at the Center will provide certified plant material of perennial crops for new plantings as they replace acreage currently in poppy production.

Training at the Center

Turkey and neighboring countries have a high level of dependence on the use of agrochemicals. Pesticides have been overused and applied under conditions where they were only partially effective or completely ineffective. This overuse of pesticides has resulted in soil and groundwater pollution with adverse effects on the environment.

Short courses and workshops on pesticide use will be taught at the new Center for extension personnel, farm advisors, and farmers from both Turkey and neighboring countries. These non-technical courses will provide instruction on how to recognize disease symptoms caused by viruses and how to distinguish them from other causes of decline. Pesticides have often been applied in excess or in situations where they have been needlessly applied and control has not been achieved. Emphasis in these classes will be on the safe and effective use of chemicals.

Short courses (3-5 weeks) and (6-9 weeks) as well as long-term courses (6-8 months) will be presented. Courses will include instruction on methods of virus detection and diagnosis using chemical and biological methods. Methods of reagent preparation and instruction in specific test procedures will be presented. The role of insect vectors virus transmission will be emphasized. These courses will designed for both beginning and advanced students seeking training in plant pathology.

International Instruction

An internationally recognized group of scientists will serve on the Steering Committee for the Center. Scientists from Italy, France, Germany the Netherlands, Israel and the U.S. will provide guidance in project development and they have all agreed to teach the workshops and classes as an adjunct to the Turkish scientific staff. Each of scientists identified has a particular specialization that makes hem uniquely qualified.

The proposed Center will play an important regional role in serving countries in the Eastern Mediterranean, Near East and Central Asia. The formation of the Center is a high priority of the Turkish Ministry of Agriculture and Rural Affairs. The Ministry requests $531,000 assistance from the U.S. government to support equipment purchases for the Center. The Turkish government will provide $59,000, or 10% of the estimated

total cost of $590,000. A four- year grant of $600,000 will be requested from the European Commission to fund the training program at the Center.



# Capacity Building and Sustainability

Background:

The principles of institutional development outlined in the policy paper developed by the U.S. in the 1980s are as important today as they were in the 80s and 90s. This paper addresses the issues defined in the USAID policy of institutional development and provides information about how the proposed research and training center meet the criteria for consideration of financial support from the Agency.

## Consideration and Introduction of Organizational Alternatives.

This approach to development places emphasis on increasing resources or opportunities to acquire resources, typically by introducing or strengthening an implementing organization. Under this guiding principle "Missions should explicitly consider the implications that an institution's proposed function may have for the form it will take and missions should ensure that the institutional structure is appropriate to the function. USAID should therefore see the task of institutional development not simply as institutional transfer, but rather as institutional invention/or adaptation".

Proposed Center in Turkey

The proposed center in Turkey is based on an established institutional structure of the Ministry of Agriculture and Rural Affairs. The proposal provides for a new research center that will fundamentally change the role virology in the Institute of Plant Protection. In the past, research progress has been limited by the lack of well-equipped laboratories able to conduct both applied and basic research in plant virology. Strengthening this capacity will allow Turkey to play a leading role in plant pathology research among Central Asian countries.

## Development of Institutional Learning Capacity

Institutions must have the ability to learn from and adapt to the environment in which they work. Such learning capacity enables organizations to adjust development programs to their environment. " For example, technology developed by agricultural researchers must be reconciled with the local knowledge, capacities, and goals of farmers for whom such technology is intended, if technology is to be generally useful and widely accepted".

Proposed Center in Turkey

The Ministry of Agricultural and Rural Affairs in Turkey recognizes the need to adapt to the changing environment of global competitiveness and the changing requirements for plant health certification. During the past several years the movement of insects and disease organisms across national and international borders has become a major concern. New laws and regulations have been implemented by many countries to prevent the introduction of harmful organisms. For example, the European Union has developed a list of strict regulatory requirements that must be met by all member states. Turkey must meet these requirements as a condition of membership. It is, therefore, essential that Turkey upgrade its plant health regulatory capability to meet these requirements. An important step in meeting these requirements includes upgrading the capacity of the country to conduct the needed research and develop improved methods of plant virus certification.

## Transfer of Knowledge and Technology

Key institutions in the development process are those that generate, adapt, and disseminate knowledge and technology at international, national, and local levels. "Technology transfer is accomplished most effectively by those countries which have a scientific establishment capable of evaluating and adapting knowledge and technologies to local conditions. The establishment of local institutions that have the capacity to tap and contribute to the world knowledge supply must therefore be a high USAID priority".

Proposed Center in Turkey

The proposed research and training center will serve not only the needs of Turkey, but is designed to also meet the needs of other Central Asian countries. More than 50% of the population in several of these countries, including Uzbekistan, Tajikistan and Turkmenistan make their livelihood through agriculture. In these, and other countries in the region, agriculture accounts for 20 to 30 % of GDP. Although cotton has been the predominant crop produced in these countries, horticulture crops are also important. For example, Uzbekistan produces vegetable and fruit products. Turkmenistan produces vegetables and has an expanding potato industry. Turkmenistan also produces a variety of subtropical fruits including pomegranates, almonds, figs and olives.

Training at the Center for individuals from neighboring countries will include students, as well as those with a basic knowledge of plant biology and pathology. Another important aspect of training will involve those individuals who work as extension agents and are in direst contact with farmers. The overuse of pesticides and the resulting chemical

pollution have created major problems for both the land and human health in several Central Asian countries. Training at the new center will enable those working with farmers to distinguish between damage caused by disease and other causes. This will provide a basis for reducing the use of pesticides and improving the environment.



## Analysis and Improvement of Institutional Linkages/ Coordination

Many developmental efforts involve more than one organization in the planning and implementation process, and so an oft-encountered problem concerns the development mechanisms which link organizations into a unified, effective whole. " Donor agencies and host country governments have experimented with a wide array of organizational structures and processes in seeking to achieve more coordinated development efforts".

### Proposed Center in Turkey

Coordination of activities at the center will be linked to a group of advisors from several European countries. Scientists from Italy, France, Germany, and the Netherlands will serve in an active role to guide the scientists and administrators of the center in developing the research priorities and the training program. All of the scientists who have volunteered for this activity have distinguished international reputations and have agreed to assist in the teaching program. It is anticipated that the training activities will include both short-term workshops as well as longer- term opportunities to pursue advanced academic degrees. Training activities will be initiated as soon as the existing laboratory facilities are adequately equipped.

## Provision of Skills and Training

Successful institutional development depends upon persons trained in appropriate technical and managerial skills. "In both skill areas a broad range of people need to be considered in training, e.g., private artisans and business people as well as government technicians, paraprofessionals, and local administrators as well as ministry personnel".

### Proposed Center in Turkey

In addition to the training opportunities described in the previous section, training classes will be designed to educate farmers in the principles and application of improved methods of disease control. As mentioned previously, the overuse and misuse of pesticides in Central Asian countries, including Turkey, is a critical situation that can only be remedied through education of farmers and appropriate education of farm advisors.

Turkey has a core of trained professional that will serve as the nucleus staff at the new center. These individuals have received training in academic institutions in the U.S. and in Europe. These scientists are trained to conduct research utilizing the up-to-date tools

to conduct the needed research. The only major obstacle to developing a modern and innovative program is the lack of equipment to conduct the research.



## Capitalizing upon Local Capacities and Participation

The first step in a broadly based development strategy which fully mobilizes available human resources is to assure that people have the opportunity to acquire resources. (e.g., land water, technology, knowledge), as well as the incentives and opportunities to utilize the resources productively. The development experience of the last two decades also indicates clearly that the impact and sustainability of public sector investments can be significantly improved if local citizens assume a role in needs assessment, project design, and implementation".

### Proposed Center in Turkey

From the beginning, development of the concept for the center by the Ministry of Agriculture and Rural Affairs has involved the Institute of Plant Protection. Initial contacts with the U.S. demonstrated the commitment of both organizations in joint planning and implementation of the project. The Institute of Plant Protection offered to commit laboratory space in a building they currently occupy. They further offered to staff the facility with three professional plant virologists and a support personnel. At a meeting in April involving both organizations and a representative of the Foreign Agricultural Service of the USDA, a timetable for implementation of the project was discussed. The research timetable and course presentations are included in this report.

## The Role of Institutions in the Development of Supporting Infrastructure

Many organizations require physical infrastructure in the form of buildings and equipment. "USAID will consider provision of capital assistance to meet these needs where resource availabilities permit, and where such assistance is integrated with sound planning to strengthen the organizational, managerial, and technical aspects of institutional capacity"

### Proposed Center in Turkey

Institutional development has been part of the USAID mission for many years. Capacity building is an important part of this mission. As described in this paper, the basic infrastructure of physical facilities and human resources are available and will be provided by the Turkish government. A lack of funding to equip the facility is the only barrier that prevents establishing the new center.

## BENEFITS TO THE U.S.

The U.S. and Turkey have maintained a long-term cooperative relationship in the field of plant biodiversity and conservation. Turkey is the native home to many of the most important food crop plants in the world. Plant collections of primitive and wild species have been made by the U.S. in Turkey for many years. These collections are part of the National Germplasm repositories in the U.S. and have provided genetic material for



improvement of many different crops. Maintaining a strong germplasm exchange program is in the vital interest of the U.S.

Development of a research and training center for plant virus control in Turkey will provide greater food security and sustainability in both Turkey and neighboring countries. The new center will create regional training opportunities for scientists, students, extension workers and farmers in these countries. Many of the countries have agricultural based economies and are encountering the same problems as those occurring in Turkey. A lack of healthy plant material of vegetatively propagated crops and the absence of plant health certification capability severely limits food production and results in the overuse of pesticides. It is the interest of the U.S. to improve agricultural output and sustainability in these countries.

BENEFITS TO TURKEY:

Turkey will have a state-of –the-art research and training facility that will serve both Turkey and other Central Asian countries. Agriculture in Turkey is in transition and increased emphasis is being placed on crop diversification. Research conducted at the center will provide a vital link in support of improving crops currently grown and in providing the scientific knowledge needed to produce disease resistant new crops. The new center will also provide Turkey with the infrastructure needed to meet the phytosanitary measures required for entry into the European Union.

Conclusion:

Regional Centers for research and training in plant virology were established several years ago in Italy and France to serve those countries and to meet regional needs in the development and implementation of technology for virus disease control. There is, however, no similar facility in Turkey of in any of the neighboring countries. The Turkish government has a suitable building and laboratories and has agreed to supply professional and support staff for the Center. A suitably equipped facility is now needed to make the Center concept a reality.

## Germplasm and Food Security

Background:

A 1999 National Research Council (NRC) report entitled “The Pervasive Role of Science, Technology, and Health in Foreign Policy_ Imperatives for the Department of State” identified biodiversity as one of the most significant issues

involving Middle East countries. Conservation of the world's biota is recognized as a high priority by many countries.

Although Turkey as a Near East Asian country was not mentioned in the NRC report, it is important to recognize that Turkey has a vast resource of biodiversity that is represented by many different genera and species. The Department of State and



the USDA have been involved in biodiversity programs for many years and each department has recognized the importance of this resource to food security and agricultural sustainability.

In 1981 a meeting titled U.S. Conference on Biological Diversity was convened in Washington. Sponsors included the Departments of State, Agriculture, Interior, Commerce and USAID. Speakers representing each organization recognized the critical need to develop programs to ensure conservation of species worldwide. The availability and use of genetic variability as an essential element in plant improvement was generally recognized. It was estimated that worldwide, about 15 species of cultivated plants literally stand between man and starvation. One speaker noted that despite the great amount of plant exploration that has occurred in the past, for some species there are still critical gaps that must be filled because of the continuous replacement of indigenous varieties with improved cultivars. Government leaders and private industry recognized that primitive and semiwild progenitors of bread wheat in parts of Turkey and adjacent areas are rapidly disappearing and must be salvaged if the genes are to survive.

In the mid 1990's the U.S. established a project titled "In Situ Conservation of Genetic Diversity" in Turkey. The objectives of the project were to identify and establish in situ conservation areas for protection of wild relatives of important food crop and forest tree species. Conservation of these resources in the field has been an important aspect of the cooperation between the U.S. and Turkey.

Many plant collection expeditions have been conducted in Turkey by the U.S. Department of Agriculture. Collection of unique germplasm has greatly enhanced the genetic resources available to researchers and commercial plant breeders in the U.S. and abroad. Acquisition of this unique material has significantly expanded the genetic base of several important crop plants that are indigenous to Turkey.

In 1999 the question of access to international germplasm collections was discussed by the National Genetic Resources Advisory Council at a meeting convened at the USDA. Concern was expressed by the council regarding the increasing restrictions placed by governments on access to germplasm. This same concern was also expressed by a representative of the State Department. The council restated its long-held position that benefits accrue to all parties when there is open and free access to germplasm collections. The council also reaffirmed the position taken by the USDA that the general practice of accepting germplasm for subsequent release without restriction should be followed.

In spite of the call for free and open access to plant germplasm, many countries now require that certain conditions be met before germplasm can removed from the country. Some of these conditions include pre-agreements on sharing economic benefits of any subsequent developments or discoveries that are of economic value. This

restriction is applied to plant material in natural settings as well as materials in existing collections.

The U.S relationship with Turkey has remained essentially the same over the years with some modification. The U.S has access to Turkish germplasm with the understanding that evaluations of the material will be made in Turkey as well as in he



U.S. This requirement continues to allow unfettered access to the germplasm and will continue to provide the U.S with unimproved plant material for further research and development.

## Germplasm in Turkey

Background:

The importance of plant germplasm was recognized many years ago. Explorations by U.S. geneticists and plant breeders were conducted as early as 1934 when alfalfa, grasses and various forage crops were surveyed. These collections were followed by the acquisition of cereals, forages and vegetable germplasm in the 1940'' and 50s. In the late 1970s and 80s the wealth of wild materials in the families of cereal crops was recognized. Collections of peas, chickpeas, lettuce, lentils, carrot and more recently apple wild relatives were added to in vitro germplasm collections. Over the years, perhaps the most important colletions were those of the wild relatives of wheat. The Turkish source of this germplasm has had a significant impact on the improvement of cultivated forms of this genus.

## BENEFITS TO THE U.S.

Maintaining a strong program of germplasm exchange is in the vital interest of the U.S. Because Turkey has unique sources of some of the world's most important food crops, there is a need to enhance U.S.- Turkey cooperation in maintaining this biodiversity. Indigenous primitive and wild species are constantly changing in the natural habitat. Plants growing in these native areas are exposed to diseases, pests, and environmental stresses result in an ever-changing population that is continually adapting to ensure survival. Access to these changing populations is essential for further improvement of new varieties.

The proposed Center will provide a location where native Turkish germplasm can be evaluated for resistance some of the most important viruses affecting the specific crop species. This information will be of significant benefit to plant breeders in the U.S. when the Turkish plant material is used in genetic improvement programs that lead to enhanced disease resistance.

## BENEFITS TO TURKEY

Turkey will have a state-of –the-art research and training facility that will serve both Turkey and Central Asian countries. Agriculture in Turkey is in transition and increased emphasis is being placed on crop diversification. Research conducted at the center will provide a vital link in support of improving crops currently grown and in providing the scientific knowledge needed to produce disease resistant new crops. The new center will



also provide Turkey with the infrastructure needed to meet the phytosanitary measures required for entry into the European Union.

The history of cooperation between the U.S. and Turkey has been one of mutual benefit to both countries. Data show that a wide range of species have been collected over a period of many years. Most of the collections have involved the acquisition of grain species, including *Triticum* (wheat), *Avena* (oats), *Secale* (rye), *Elymus* (wildrye), and *Zea* (corn). Many of these wild collections were returned to Turkey following their identification.

Current Situation:

Turkey is initiating programs in the development of new horticulture crops. Some of these crops have been previously cultivated on a limited scale and others are being introduced for the first time to widespread cultivation. As a result of this redirection there is an increasing need for unimproved germplasm that can be utilized in breeding programs. Examples of these crops include grapes, sweet and sour cherries and a range of new vegetables.

In the past, Turkey has taken only limited advantage of the horticultural genetic resources available from the USDA for plant improvement. Many of the collections of horticulture crops of current interest to Turkey are part of the national collections network in the U.S. This network is composed of twenty eight different locations. Information describing the content of these collections is fully computerized and is part of the Germplasm Resources Information Network. Germplasm is available to plant breeders and scientists working in both government and non-government venues in Turkey.

Turkey is entering a new phase of crop development that requires both the availability of unrestricted germplasm and the resident expertise to develop virus-resistant new varieties. Implementation of the plan to establish a new research and training center for plant virology is a high priority for the Turkish Ministry of Agriculture and Rural Affairs.

## VIRUS DISEASES IN TURKEY

Background:

The Cukurova Plain is the most important agricultural area in the Eastern Mediterrean Region of Turkey. Major horticultural crops include grapes, citrus, stone fruits, citrus, olives and a range of vegetable crops. Because of the suitable growing climate, soil

fertility and irrigation practices this region has a wide variety of diseases and pests. The major losses in these crops result from virus infections. Crop losses range from 10 to 20 % depending on the crop and viruses present and the occurrence of insects that transmit some of the viruses.



During the last several decades a wide range of plant material was brought to Turkey. In addition to known virus diseases, new viruses and virus-like agents have been discovered as cultivation of introduced crops has expanded. Viruses have been identified in both annual and perennial crops. Infected annual crops include tomato, pepper, eggplant, bean, cucumber, melon, and watermelon. Viruses identified in a recent survey are listed in Table 1. They include many, but not all, of the disease agents known to occur in the U.S. Since most of the Turkish isolates have not been characterized, there are probably strain differences and possible differences in the economic damage caused in Turkey and the U.S.

The most important perennial crops grown in Turkey are grape, olive, citrus, stone fruits and several nut crops. Viruses identified in these crops are listed in Table 1. Additional virus surveys, particularly stone fruit viruses, are in progress. In addition to the viruses known to occur in the U.S. new disease agents have been described infecting perennials in Turkey.

## Safeguarding American Plant Resources

In July, 1999 a stakeholder report reviewed the operations of the Animal Plant Health Inspection Service (APHIS) – Plant Protection and Quarantine (PPQ). The review, conducted by the National Plant Board, identified areas of needed improvement in procedures to enhance pest exclusion, methods of detection of invasive species and organizational accountability.

In a section of the report titled “Offshore Activities” the report concluded that “pest risk mitigation at the point of origin, i.e. offshore, is the most viable approach to pest exclusion and mitigation. Necessary and associated activities include the identification of invasive pest and disease threats, development of preventative and contro; measures, and directed research with mutual benefit received by the U.S. and the country of origin”.

The report further stated that “an offshore exclusion strategy that incorporates a commitment by the U.S. TO ASSIST COUNTRIES IN TRANSITION WOULD PROVIDE AN OPPORTUNITY FOR THE U.S. TO USE EXPERTISE TO IDENTIFY AND MITIGATE CURRENTLY UNQUANTIFIED PEST RISKS’.

## Current Situation

Citrus Chlorotic Dwarf Disease (CCD) is an exotic disease affecting lemon, grapefruit, mandarin, and sweet orange in Turkey. The disease does not occur in the U.S. CCD is currently recognized as the most serious disease of citrus in the Mediterranean region.

Scientists hypothesize that the whitefly borne disease agent is a virus, but this has not been proven.



Experiments were conducted on CCD in quarantine isolation in a cooperative project involving ARS and Turkish scientists in Beltsville. The project was terminated when the visiting scientist returned to Turkey. This did not result from lack of interest since both the U.S. and Turkey regard research on this disease a high priority for the citrus industry in both countries. The project could not be continued in Turkey because there was no laboratory suitably equipped to conduct the purification and characterization research. Research on CCD could be continued with the initial purchase of a superspeed and an ultracentrifuge for further studies on the nature of the disease agent. Note: (Additions of other equipment can be made incrementally as funds become available. A complete list of equipment is included in this report. All of the equipment that will be needed when the research and training components of the project are fully implemented).

CCD poses a potential serious threat to the U.S. citrus industry. Further research on the identification of the causal agent and associated field research on transmission can be conducted only in Turkey. The Turkish Ministry of Agriculture has indicated that the cooperative research would continue and U.S. scientists would be invited as visiting scientists to continue the research in Turkey.

In addition to CCD other exotic citrus diseases in Turkey include Cristacortis, Impietratura and Concave Gum. Research on the nature of these diseases and the potential economic damage they might cause to the U.S. industry should to be evaluated.

## Other New Diseases

Potentially important exotic diseases identified in Turkey include agents in annuals and perennials. Viruses initially identified in one crop may produce significant economic damage in another. For example, olive latent virus has recently been identified infecting citrus. This new strain is a necrovirus, but has not been fully characterized. Another recently recognized severe disease in cucurbits, named cucurbit aphid-borne yellowing, was identified in Turkey. These are two examples of virus diseases that should be further characterized and methods of detection and control should be developed in Turkey. Research on these and other new virus diseases that are recognized in the future in Turkey and the surrounding countries will support the objective of safeguarding American plant resources.

Table 1. Virus and Virus-like Disease Agents Reported in Turkey

Annual Crops

Artichoke Latent
Barley Yellow Dwarf
Bean Leafroll



Bean Yellow Mosaic
Cowpea Aphid-Borne Mosaic
Cucumber Mosaic
Cucurbit Aphid Borne Yellow Virus
Cucumber Vein Yellowing Virus
Eggplant Mosaic
Maize Dwaf Mosaic
Papaya Mosaic
Pepper Mild Mottle
Potato Virus Y
Potato Leafroll
Tobacco Etch
Tobacco Mosaic
Tobacco Ringspot
Tomato Spotted Wilt
Tomato Yellow Leaf Curl
Watermelon Mosaic
Zuccini Yellow Mosaic

Perennial Crops

Arabis Mosaic
Cherry Leafroll
Infectious Variegation
Citrus Gummy Bark
Corky Bark
Fleck Virus
Grapevine Leafroll
Olive Latent
Psorosis A (Citrus)
Psorosis B (Citrus)
Strawberry Latent Ringspot
Tristeza (Citrus)

Virus-Like Diseases

Citrus Chlorotic Dwarf
Cristacortis
Impietratura
Concave Gum

Viroids

Cachexia
Exocortis



Spiroplasma

Stubborn (Citrus)

BENEFITS TO THE U.S.

Formation of a research and training center for plant virology in Turkey will provide a new level of protection for U.S. agriculture from the threat of invasive species. Turkey has disease agents that do not occur in the U.S. but could pose serious agricultural production problems if they are introduced into the country. Research on these viruses and virus-like agents in Turkey is consistent with the objectives identified in the report of the National Plant Board and is and extension of the kinds of programs APHIS supports in controlling insect pests. In the long-term, it is likely to be less costly to the U.S. economy to develop disease management strategies based on information gained about plant pathogens in areas or regions where they are endemic than later after they are introduced, and become established in the U.S. The proposed center is a high priority for the Ministry of Agriculture and Rural Affairs in Turkey. The Turkish government will supply buildings, staff and partial payment for the needed equipment that is identified elsewhere in this document. It is anticipated that because of the importance of this project in meeting the domestic and foreign policy objectives of the U.S. government, the funding required will be divided among the different U.S. Federal departments and agencies.

BENEFITS TO TURKEY:

Implementation of the center program will greatly enhance the ability of Turkey to produce quality agricultural products that will meet international certification standards. National needs include meeting the phytosanitary requirements for entry into the European Union. This objective is a high priority for Turkey and is important in U.S. foreign policy. Production of horticulture crops currently grown is increasing and additional new crops are being produced as the program of national diversification of agriculture expands. It is essential to further develop and improve plant health certification programs, particularly for perennial crops. These crops are often grown for many years without replacement of the original planting stock. It is essential to develop a national program that ensures that the initial planting stock is free of known viruses and that an ongoing program of testing and evaluation is employed to maintain a high standard of plant health. This is an issue that relates to product quality and, in some instances, may be a barrier to export if an uncertified product poses a threat to the agriculture of the importing country.

# Poppy Production Alternatives-
## Role of the Research and Training Center in Supporting Turkish Farmers in Crop Diversification

Background:
Turkey is a major producer of opium poppies for the manufacture of pharmaceutical drugs. Although poppy cultivation in Turkey is strictly controlled and growers are licensed, production of opium poppies and other illicit drugs is a major problem in other countries in the region. One approach to control is direct eradication of the crops. Eradication will, however, be successful only if suitable farming alternatives are provided to poppy growers. Alternative farming must be based on healthy planting material and appropriate production technologies. Planting and maintaining virus-free crops is an important component of the crop protection system.

New approaches should be explored to assist farmers involved in transition agriculture and new crop production in Turkey. The technology needs in Central Asian countries where drug plants are produced for the illegal trade also need to be addressed. The proposal described in this paper is and effort to assist farmers who are making the transition from drug plant production to food crops. Alternative, high quality production of fruits and vegetables will have to be produced to make up for the income losses as the land for poppy production in Turkey is reduced. A new research and training center for plant virology will provide the technical assistance and practical measures required for long term expansion of the fruit and vegetable crop industries. There is no research and training center for plant virology in any Eastern Mediterranean or Near East country. The proposal described in this paper is endorsed by the Turkish Ministry of Agriculture and Rural Affairs and is a high priority for the Government of Turkey.

National Security and the Food Supply

Turkey is the largest producer and exporter of agricultural products in the Near East and African region. The agriculture sector is highly diversified. Nearly 18 million acres are devoted to field crops including cereals, pulses and industrial crops ( sugarbeets and cotton), and potatoes. The principal vegetable crops are tomatoes, melon, watermelon, cucumbers, eggplant, peppers and various leafy vegetables and legumes. Agriculture in Turkey accounts for more than 14% of GDP. Nearly 41% of the labor force is engaged in agriculture.

In contrast to Turkey, several other countries in the region are impoverished. This has resulted from their previous affiliation as part of the Soviet Union. Under Soviet control for many years the republics were charged to grow a limited number of crops. For

example, Uzbekistan, Tajikistan and Turkmenistan all grew cotton as the dominant agricultural crop. In these countries nearly one-half of the labor force is involved in agriculture. Although these countries economies are based in agriculture, they each must receive humanitarian aid to sustain the population. In FY 2002 Uzbekistan will receive



$60 million and Tajikistan will receive $75 million in food aid from the USDA through programs at the Department of State.

Development of a sustainable system of food production should be a U.S. goal in the impoverished countries of the region. The U.S. supports a Farmer-to-Farmer program managed by USAID. This and other programs should be used as vehicles to promote the education of farmers, students and agriculturists in these countries in technologies and practices that are applicable to conditions in the region. This is particularly important since the concepts and methods that are utilized must be compatible with ongoing farming practices.

Food security is of major importance in creating a stable and secure environment in several of the countries neighboring Turkey. The development of the proposed Research and Training Center will provide needed expertise that will allow a transition from the dominance of cotton production to production of fruit and vegetable crops. This transition to other cropping system will require considerable time and effort. The Government of Turkey has made a commitment to provide the needed research support and training in the proposed new Center.

## Mitigation of Illicit Drug Production in Afghanistan

Afghanistan is an agriculturally based country with the majority of the labor force involved in farming. More than twenty years of war have left the economy of in ruin. Infrastructure supporting agricultural production has been largely destroyed. During the last year production of illicit drugs, particularly opium poppies, has significantly increased. Farmers are in a desperate situation since several years of drought has resulted in failure to produce sufficient amounts of grain, fruit and vegetable crops to sustain the population. As a result, the U.S. and other nations have exported large quantities of food aid to Afghanistan.

Afghanistan needs technical support to help farmers return to the production of food crops. In addition to developing water and irrigation projects a high priority should include an emphasis on the assistance needed to increase the production of fruit and vegetable crops in addition to grains.

In a June 2002 report, “Rebuilding Afghanistan”, USAID established “Restoring Food Security and Revitalizing Agriculture and Other Livelihood Options” as one of four major goals. USAID is making efforts to revitalize the economy by promoting the cultivation of high-value crops such as raisins, other fruits and vegetables. Cash –for –work projects employ local Afghans to rehabilitate critical infrastructure such as farm-to –market roads and irrigation systems, according to the report.

The report goes on to say that experts are training farmers in planting methods, crop protection, and animal husbandry. USAID is funding Mercy Corps International to plant fruit-tree nurseries and distribute saplings.



The proposed Center will be the only scientific laboratory and training center in the region that can provide the needed scientific expertise and training to accomplish the objective of improving plant health and virus control on a regional basis. Many of the disease problems encountered in Afghanistan will be the same as those present in the neighboring countries, including Turkey. Formation of the new Center in Turkey will be an important step in improving food production in Afghanistan.

BENEFITS TO THE U.S.

Enhancing the in-country capability of Turkey's neighbors through assistance in research and training offered by the new center in Turkey will greatly strengthen the transition of these countries toward self sufficiency in food production. Basic humanitarian and food aid will be an ongoing requirement in Central Asian countries. Providing assistance sponsored through the Turkish government will, however, support the long-term objectives of greater stability, sustainability, and food security goals consistent with U.S. foreign policy objectives.

BENEFITS TO TURKEY:

Maintaining economic viability for farmers is a high priority for the Turkish government. Making a transition from producing opium poppies to marketable fruit and vegetable crops requires strategic planning and the involvement of many sectors of agriculture. One of the important considerations in this crop diversification effort is the introduction and maintenance of healthy plant material. Many of the new crops planted as a substitute for poppies are perennial crops and must be maintained in a healthy state for many years to preserve the yield and quality. Through the introduction of virus-free plant material and the development of sensitive diagnostic tests, the proposed Center will play a vital role in supporting Turkish agriculture.

# Project Timelines
# 2004-2007

## Year 1

The first year of the project will be devoted to equipment acquisition. Objectives of the project cover many different areas of interest to the U.S. including germplasm, sustainability, food security and crop diversification. The project goals involve the missions of several federal departments. A priority of equipment acquisition has been prepared. Purchase of the superspeed centrifuge and ultracentrifuge are the highest priority since they will allow the initiation of experiments in a first step in pathogen

characterization. This will be followed by the purchase of several other instruments to support research on pathogen characterization and virus identification. (See Instrument Acquisition Priorities). The single most expensive item is the electron microscope. This purchase should be made as soon as possible as it will provide for direct monitoring of



results of virus purification studies. The microscope can also be used to support implementation of certification standards in the development of virus-free vegetatively propagated planting material for field distribution.

A tentative selection of research projects is proposed. This list will be reviewed and prioritized with input from the Steering Committee.

## Research Goals

1. Conduct a survey to identify the occurrence and identity of those viruses in the major economic crops that cause the greatest losses in quality and productivity.
2. Develop new methods to improve the reliability of detection and diagnosis of specific viruses.
3. Conduct research on the use of specific methods of nucleic acid hybridization, immunological detection or other procedures that may be selected for use in large-scale testing and certification programs.
4. Conduct studies on modes of insect transmission of specific viruses and develop appropriate methods of control.

Student training in laboratory methods of virus purification, identification and characterization at the University of Cukurova can begin as soon as the centrifuges and supporting equipment are installed. Currently, students have exposure in the use of this equipment when they study abroad, but resident students will, for the first time, be able to conduct the experiments in relation to their formal class work. If most of the equipment items are installed in the first year, scientists from Europe and the U.S. can go to Turkey to begin teaching and conducting laboratory work.

Training courses and workshop presentations will be made in the first year based on the classes listed in the attached Workshops and Courses outline. These classes will be oriented primarily toward the beginning student. Provision is being made to teach a very practical course in field recognition of virus diseases and proper use of insecticides to control insect vectors.

Infrastructure needs will be initiated to upgrade air conditioning for the electron microscope, complete electricity upgrades as needed and improve water quality where needed.

Note: A major request for financial support will be made from the European Union. These funds will be primarily used to support the training aspects of the program and will include funding for supplies and materials used in the research and training programs.



## Year 2

Research projects will be classified as basic and applied depending on the state of knowledge and needs set out by the Ministry of Agriculture. For example, an improved nucleic acid hybridization method for detection and diagnosis of tomato yellow leaf curl virus will be actively pursued. Grape virus identification studies will be initiated. This will be essential to achieve the goal of developing virus-free grape planting material for distribution to farmers in areas where diversification programs are initiated. Similar studies will be planned on stone fruits, but not initiated, due to the personnel limitations.

Planning of classes and workshops will be continued with input from members of the Steering Committee who will be teaching at the Center. Members of the Steering Committee will be asked to provide support from their own institutions for travel to Turkey to complete the training plans and begin teaching. Each of the members of the Committee realize the importance of the project and are committed to its success. Some short-term technical courses will be presented. Most of the long-term courses will probably be initiated in Year3.

## Year 3

Research projects initiated in Year 1 will be assessed for progress in meeting the goals initially established. Work will continue in developing improved methods of nucleic acid detection and new work will begin on the development of antiserum to the viruses that have been characterized. This work will be important in developing improved serological methods of identification, strain comparison and field diagnosis of specific diseases. This objective will be important in meeting the goal of certifying and maintaining vegetative propagation stocks that are virus free.

Several training classes and workshops will have been offered by this time. ( See Workshops and Courses) The success of these training activities will be measured in several ways. On a practical scale, a measure of success can be measured by determining the extent that pesticide use is decreased in field control. This can be done as part of research projects that monitor the occurrence of specific insects in relation to the incidence of disease and the effectiveness of alternative methods of control. Another measure of success of more advanced formal training courses will be an assessment of student accomplishments based on an understanding of the material presented and the successful completion of a research project.

## Year 4

The initial research projects related to detection of tomato yellow leaf curl virus should be nearing completion and results applied to field control of the disease. Viruses

from grapes will have been isolated, purified and partially characterized. Antiserum will have been prepared for those viruses where serological detection procedures are applicable. The Steering Committee will review progress and make recommendations for possible modification of existing projects and will make recommendations on the direction and development of new projects.



Training courses offered will be reviewed for content and effectiveness by the Steering Committee. Modifications will be made as needed. By this time, funding from the European Community should have established a regular schedule of visiting scientists who will reside in Adana for longer periods of time when they teach specific courses of longer duration than the short term workshops.

## Workshops and Courses

### Year 1

Mini-courses –

How to control virus diseases and reduce pesticide use

How to recognize virus disease symptoms

Detection and diagnosis of virus and virus-like diseases

Epidemiology of virus diseases in Central Asian countries

Applicability of certification programs in Central Asian countries

Note: These are general introductory workshops designed for beginning students, field practitioners and farmers.

Short-term courses-

Virus detection and identification using biological methods

Detection and diagnosis of virus diseases using commercially available test kits

Purification and characterization of viruses

Note: Presentation depends on the availability of centrifuges

### Year 2-4

Short-term courses-

Application of serological test procedures in virus detection

The electron microscope in virus detection and disease diagnosis

Detection of viruses and phytoplasmas utilizing the polymerase chain reaction

Virus vectors and approaches to control



Principles and application of nucleic acid hybridization and polymerase chain reaction procedures in virus detection

Note: Short-term courses of a technical nature will be 2-4 weeks duration

Long-term courses-

Immunology—Preparation of serological reagents, including virus purification, immunization of test animals, enzyme-linked immunosorbent assay procedures, use of monoclonal antibodies in virus detection and related technologies

Transgenic Plants and Virus Resistance—This course will focus on the choice of genes, methods of transformation and procedures utilized in establishing resistant selections

Vectors and Epidemiology-- In this course methods of transmission of virus and virus-like diseases will be presented. Methods of insect trapping and identification will be evaluated. Application of control methods including oil sprays, reflective mulches, mixed cropping combined with limited use of pesticides will be part of this curriculum.

Certification—This course will focus on implementation of Certification schemes in countries in the region according to their priorities. The project "Improvements of the Citrus Sector in The Mediterranean by the setting up of Common Conservation Strategies for Free Exchange of Healthy Citrus Genetic Resources" prepared by FAO_MECINET_MNCC networks can be used as a starting point for training activities and common targets. ( This course may be presented as both a short-term and long-term course)

Note: Each of these courses will include lectures, laboratory work, seminars and literature search. The courses will be limited to 8-15 participants with most participants holding a B.Sc. or M.Sc. degree. It is suggested that a limited number of PhD students will conduct their research at the Center in cooperation with the respective Turkish university. Teachers will be invited from countries that cooperate in the project.

# Equipment Priorities and Estimated Costs

Major Equipment:

1. Preparative Refrigerated Centrifuge and Ultracentrifuge and Rotors.
   Actual Cost ---------- -$ 124,000

2. Electron Microscope Actual Cost ---------- $ 259.000

3. ELISA Reader ---------- $ 5,000

4. Electrophoresis Equipment ----------$ 4,000

5. Polyacrylamide slab-gel system---------- ---------- $ 5,000

5. Thermocycler ---------- $ 7,000

6. Microfiltration System ---------- $ 4,500

7. Speedvac DNA concentrator ---------- $ 5,000

8. Microfuge----------$ 4,000

9. Electrophoresis camera---------- $ 2,000

10. Spectrophotometer ---------- $14,000

11. Temperature controlled water bath----------$ 2,000

12. Ice machine----------$ 4,000

12. Freeze dryer---------- $ 5,500

13. Fluorimeter ---------- $ 6,000

14. Deep Freezers and Refrigerators ---------- $ 25,000

15. Laminar Flow Benches ( 2 )---------- $12,000

16. Incubators ---------- $15,000

17.Computers ---------- $ 15,000



18. Supplies (includes small equipment i.e., blenders, glassware, chemicals, etc. to initially support the project ----------$ 72,000

TOTAL $ 590,000

Note: Actual costs may vary from the estimates depending on whether items can be acquired on GSA contract.

The government of Turkey will be responsible for infrastructure costs including electrical upgrades as needed, water purification systems, greenhouse renovation and construction of a small animal facility to house rabbits for antiserum production.

## Research and Training Plans

Appendix 1

## A Facility for Turkey and Neighboring Countries

### NEED & RELEVANCE

The agricultural sector plays an important role in the Eastern Mediterranean and Near East Countries. About 9.7 million workers (around 41% of the total labor force) are working in agricultural enterprises in Turkey. This accounts for 14.3% of GDP. The arable crop sector accounts for more than three-quarters of agricultural production in Turkey. In 1999, imports to the European Union (EU) from Turkey amounted to US $1,993 million. Horticultural crops (fruit trees, vegetables, grapes, and ornamentals) are the second most important group after cereals.

Because of the diversity of crops and favorable climatic conditions many of the horticultural crops in the regions mentioned suffer from severe plant virus diseases. An increased capability
in plant virology is needed to meet the goals and objectives of the Turkish Ministry of Agriculture and the EU requirements for plant health. Some technologies currently used have been imported. There is, however, no laboratory or research facility to support the goals of virus identification, detection and control utilizing current technologies. As a result, the infrastructure capability is inadequate to meet current and future plant health certification needs.

Virus problems

Tomato yellow leaf curl virus [TYLCV] and tomato spotted wilt virus [TSWV] are found in tomatoes grown in Mersin, Antalya, Izmir both in the open field and under protective covers (Yilmaz, 1999). Other vegetable crops such as cucurbits, including melons, watermelon, cucumbers and squash suffer markedly from zucchini yellow mosaic virus [ZYMV]). In some melon and watermelon fields losses can reach 60-80%. In pepper,



potato virus Y [PVY] and tobacco mosaic virus [TMV]), in broad bean, bean yellow mosaic virus [BYMV] and bean leafroll virus are viruses known to cause major losses in many of the production areas, including the Cukurova and the Eastern Mediterranean Regions.

Potatoes become heavily infected with several viruses after 2-3 growing seasons, which necessitates the import of new "seed potatoes". These "seed potatoes" routinely introduce various fungal and bacterial diseases.

Citrus plantings are heavily infected with viruses. Psorosis and Concave gum are widespread, mainly in navel oranges, with a resulting decrease in yield and quality. Tristeza is a constant threat, existing in the Cukurova and Aegean regions. Turkey has initiated a citrus budwood program, but for some of the disease agents improved indexing methods need to be developed and adapted in the production areas.

One of the major aims of the Turkish Ministry of Agriculture and Rural Affairs is to make a major expansion of the grape industry. Vineyards in Turkey at the present time are infected with several viruses including grape fanleaf virus, arabis mosaic virus, and strawberry latent ringspot virus. Yield losses caused by viruses in grapevines significantly increase over a period several years following infection. A prerequisite for expanding the industry into new areas of production is to produce certified virus-free budwood.

Although damage by virus diseases has been observed in many crops and regions, sometimes with devastating effects, no quantitative data are available. More so, in many cases the causal agent has not yet been identified due to a lack of equipment and the need for more trained personnel. The use of imported serological kits for virus detection provides for testing a limited number of viruses. It does not provide a research capability needed to conduct more than routine tests. Serology (ELISA and ISEM) needs to be supported with the capability to prepare antiserum and conduct electron microscope analysis. Also, for control of virus diseases, advanced techniques for studying virus-vector relationships and proficiency with tissue culture work for obtaining virus-free base plants and budwood are of major importance. The necessary equipment such as ultra- and high-speed centrifuges, electron microscope, thermocyclers, -70 $^{o}$C deep freezers, etc. are at present also not available in plant virus laboratories.

Teaching and Research in Plant Virology in Turkey

Basic courses in Plant Virology are offered by several Universities in Turkey, *inter alia* at Cukurova University in Adana, Ege University in Izmir, Ankara University, etc. Elementary facilities for virus identification, e.g. greenhouses for test plants and serodiagnosis, are available. However, more sophisticated equipment for identification and facilities for molecular biology work are lacking. As a result, M.Sc. and Ph.D. studies in Plant Virology are done to a great extent, if at all, in laboratories outside Turkey, not necessarily on subjects of major importance to Turkey.

Current Control Methods Practiced in Many Countries

Various means are today available to control, or at least decrease virus diseases, as supply of virus-tested planting material, resistant or tolerant varieties, vector control, transgenic resistant plants etc. Thus, in many countries virus-tested seed potato tubers are produced locally. Local production of virus-tested potato seed would prevent the introduction of various fungal and bacterial diseases. Certified budwood for the fruit industry should improve quality and yields. The severe damage that occur in various



vegetable crops as TYLCV in tomatoes, ZYMV in cucurbits and TSWV in peppers are partially controlled in other Mediterranean countries by vector control and tolerant varieties. A prerequisite for developing and applying these methods is to have qualified plant pathologists and virologists. The latter are needed in Turkey. The addition of newly trained virologists will also LEAD FARMERS TO REDUCE THE USE OF EXCESSIVE AMOUNTS OF PESTICIDES through more accurate and reliable evaluations of disease aetiology. The ability to make critical distinctions between diseases caused by viruses compared to other pathogenic or abiotic causes is an essential extension of research conducted by the centre.

## EXCELLENCE, INTEGRATION AND STRUCTURING EFFECT

Research and Training Center

To achieve the goals of the Turkish Ministry of Agriculture and the European Union a research and training center of excellence, appropriately staffed and equipped, should be established as soon as possible. Such a center will have to develop the necessary methods of identification which can easily be adopted in other Turkish institutions and in neighboring countries (See Appendix I). The second function of the center will be to train scientists and other experts in plant virus technology (See Appendix II). The center will also be involved in major research projects that are of national and regional importance (See Appendix III).

The center will not only serve Turkey, but also other Eastern Mediterranean, Near East and Central Asian Countries. The center will help to advance scientists capabilities and improve co-ordination between core-research teams of those countries. At present there is no comparable center in Turkey.

Turkish authorities in the Ministry of Agriculture have concluded that such a center should be located at and integrated with the Plant Protection Research Institute in Adana in co-operation with the University of Cukurova. The Institute has the building and laboratories available for housing the center. Both institutions recognize that the center will have a mandate to cooperate with other Institutions in Turkey and with other countries in the region. Scientists from other countries, *inter alia* France, Italy, the Netherlands, Germany, US and Israel, have expressed their willingness to provide scientific co-operation, guidance and support.

A Steering Committee has been formed that will consist of:

Prof. Mehmet Asil Yilmaz, Cukurova University, Adana, Turkey
Prof. Onder Tuzcu, Cukurova University, Adana, Turkey
Dr. Ahmet Kusdemir, Plant Protection Research Institute, Adana, Turkey
Dr. Ahmet Arslan, Head of the Plant Diseases & Weed Science Division, General Directorate of Agricultural Research, Ministry of Agriculture & Rural Affairs, Turkey

Dr. Melike Yurtmen, (co-ordinator of the project from the Turkish side), Plant Protection Research Institute, Adana, Turkey
Prof. Giovanni P. Martelli, CNR, Bari, Italy
Dr. Hervé Lecoq, INRA , France
Prof. Josy Bové, INRA, Bordeaux
Dr. J. Schubert, Aschersleben, Germany
Dr. R.H. Lawson, USA



Dr. Carol Kramer-LeBlanc, USA
Dr. G. Loebenstein, Israel
Dr. H. Huttinga, (co-ordinator), Naktuinbouw, the Netherlands.

The committee will meet once a year in a country to be determined by the project co-ordinator, for the evaluation of the activities of the centre and to discuss plans for the future.

Scientists from other European countries will also be asked to co-operate and participate in the training activities of the center.

Staff and Facilities

The center will have a small permanent staff of 2-4 Senior scientists, 3-4 permanent qualified technicians and one permanent greenhouse attendant. Other scientific staff will be employed on project basis and guest scientists from other Institutions in Turkey and abroad.

Facilities should include an insect-proof greenhouse, laboratory facilities, an ultracentrifuge (apparently not at disposal in any Plant Virology Laboratory in Turkey), refrigerated high-speed centrifuge, thermocycler, ELISA reader, electrophoresis equipment, electron microscope, etc. A small animal house for keeping rabbits will be required.

The Turkish Institute will provide the necessary laboratories, offices and lecture rooms. The Institute will also provide a greenhouse, which will require upgrading.

## CONCLUSION

This proposal centers on the Capacity Building for Plant Virology in Turkey mainly for horticultural crops. This should markedly improve not only the quality and yields, but also reduce the amount of pesticides used. At present, due to absence of knowledge, farmers often unnecessarily spray their crops against virus diseases or their vectors, while the real answer is to use resistant cultivars or certified propagation material. This, should reduce the input of undesirable chemicals into the crop and the environment. This center may also be of help to the Turkish Plant Protection Authorities in formulating their guidelines in accordance with those of the EU.

In addition, because of Turkey's close ties of with other Mediterranean, Near East and Central Asian countries, this centre could help to strengthen Plant Virology in the co-operating countries.

**Appendix 1A**

**Development of test methods for identification**

- *Surveys.* Research at the center will initially be involved in updating the assessment of viruses and virus-like pathogens (phytoplasmas and spiroplasmas) present in the major economic crops. Transmission of suspected viral agents will be conducted first with those crops where the greatest economic damage occurs. Methods will include mechanical transmission, budding, grafting and insect vectors where applicable.



- *Test plants.* A collection of standard test plants will be assembled, as *Nicotiana* spp*., Chenopodium* spp. *Gomphrena* spp*., Petunia* spp*., Datura* spp*., Catharanthus* spp*., Physalis* spp*.,* tomato, cucumber, squash, etc. These plants as well as others will be grown in a standard soil mix to obtain uniform plants.
  Indicators for vegetable, grape, fruit tree and citrus viruses will be grown.

- *Serology***.** Various ELISA methods as the double sandwich, indirect and dot ELISA will be adapted for the many viruses affecting vegetables, grapes and fruit trees. In the beginning commercial antisera will be used and later for those crops and viruses where mass testing may be required, as in potatoes, antisera will be prepared from locally purified virus. Once an electron microscope will be available immunosorbent electron microscopy will be adapted for some of the more important viruses.

- *Nucleic acid hybridisation tests***.** An assay system for detecting tomato yellow leaf curl virus (TYLCV) and other viruses will be developed.

- *Polymerase chain reaction (PCR)* PCR-based methods will be developed for fruit tree viruses.

**Appendix 1B**

**Areas of Training**

Mini-courses of one week will be presented to extension personnel, farm advisors and farmers. These non-technical classes will provide instruction on how to recognize pathogenic disease symptoms and how to distinguish virus diseases from other causes of decline. Emphasis will be placed on appropriate methods of control and the proper use of pesticides.

Short (6-9 weeks) and long -term (6-8 months) technical courses will be organized in the several areas. Courses will include methods of virus detection and identification using chemical and biological methods. Instruction will be given in the preparation of reagents and specific test procedures. The role of vectors in virus transmission and vector control will be presented. These courses will be designed for beginning and advanced students in biology and plant pathology.

Examples of courses include:

- How to control plant viruses and reduce pesticide use

- Diagnosis of plant virus diseases and virus-like organisms
- Epidemiology of virus diseases in Central Asian countries
- Applicability of certification programs in Central Asian countries
- Serological methods in virus detection
- The electron microscope in virus detection and disease diagnosis
- Detection of viruses and phytoplasmas utilizing the polymerase chain reaction



- Vectors and approaches to control

Each of the short and long-term courses will include lectures, laboratory work, seminars and literature search. The courses will be limited to 8-15 participants with most participants holding a B.Sc. or M.Sc. degree. It is suggested that a limited number of PhD students will conduct their research at the Institute in co-operation with the respective Turkish University.

Teachers will be invited from countries that co-operate in the project.

**Appendix 1C**

**Suggested Areas of Research**

The priorities outlined by the Turkish authorities are virus diseases in grapes, vegetables and fruit trees:

- *Grapes*
  Study of the viruses and viroids, diagnosis and transmission and preparation of certified budwood.

- *Vegetables*
  Tomatoes- TYLCV (alternative hosts, repellence of vectors, tolerant varieties), cucurbits- ZYMV (resistant or tolerant varieties, immunisation), tomato stolbur.

- *Fruit trees*
  Identification of viruses and virus-like organisms using biological and molecular methods.