

## SUSTAINABLE VITICULTURE ACTIVITIES IN TURKEY

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### **Abstract**

Turkey is one of the most favorable viticulture area, vine culture was began first in there, and rich by wild (*Vitis vinifera* ssp. *Sylvestris*) and culture grape (*Vitis vinifera* ssp. *Sativa*) genetic resources that collected more than 1100 in National Collection Vineyard (NCV) in Tekirdag Viticulture Research Institute (VRI). Nowadays there is about 3.5 million tons grapes producing in 530.000 hectares mainly utilize for raisin (37%), table grape (30%), fruit juice (30%), and wine (3%) with around 80 standard cultivars grafted on almost 6 standard rootstocks in 9 viticulture regions in that Aegean and Mediterranean are more fruitful as economic aspect.

Turkey is the most important raisin grape producer by cv Sultani (synonym Sultana) around 75% has been exporting different countries, and fifth big table grape producer that also has been exporting different countries. There is well development of organically certificated grape production in last decade as raisin and table grape production.

In this paper, Turkeys grape germplasm evaluation, variety and rootstock utilization, planting material propagation, planting, constructing the trellis, some production practices such as ground work, pruning and trellising, grape leaf production, pest management, irrigation, floor management and harvesting topics briefly described and analyzed.

**Key Words:** Viticulture activities, Turkey, table grapes, raisin grapes, production.

### **INTRODUCTION**

During 2004-2005 period the world grapes grown area is 7.320.445 hectares and fresh grape production is 66.413.393 tons. At the same time Turkey's acreage of grapes grown area is 530.000 hectares that ranks fourth of greatest acreage followed by Spain, Italy and France. Turkey has 3.650.000 tons fresh grape production that is sixth followed by Italy, Spain, France, US, and China (FAO 2005).

Turkey is situated between 36'-42' north latitudes and 26'-45' east longitudes, one of the most favorable areas for viticulture, which has an old past in the cradle of great civilization, and one of the main fruit production centers of the world. Several types of climate leading to increase product variety and the near vicinity have made Turkish fruits and vegetables popular. Turkey produces 80 types of fresh fruit and vegetables out of 140 products grown in the world. Out of types of fresh produce, 50 kinds are subject to experts.

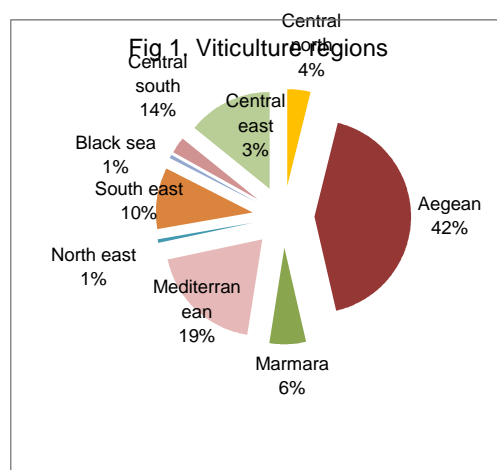
A feature of recent industry expansion has been the increased planting of varieties specific to the end use. Sultana is the most important raisin variety that it has been using as table grape. There is well development of mechanization in the vineyard, particularly in the table grape and raisin industries. The viticulture industries in Turkey are well developed, innovative and utilize the latest production practices. Turkey is ranked among the top 10 countries in terms of average grape yield (t/ha). A substantial research, development and extension effort continues to generate practices that improve production efficiency and grape quality.

Grape growing is the largest fruit industry in Turkey that is grown commercially in 7 regions (Fig 1). Raisin and table grape productions are the largest and predominant of the two viticulture industries.

### VITICULTURE REGIONS

Turkey vine regions and range of grape production is indicated in Fig 1 (Çelik at al 2005). Aegean region has the first place in area and in production. Mediterranean and South East regions were the second and third place both in area and grape production. Concerning total acreage and production of grape is almost not increased at last decade.

Aegean vineyard area is 28.5% of Turkish total vineyard area and 45.6% of total grape production. Mediterranean and Marmara regions are followed this. Table grape and wine grape vineyard plantations are being rapidly development.



### UTILIZATION OF GRAPES

The utilization of grape in Turkey is manifold, unlike such as France, Italy, Spain and Germany where more than 90% of grape produce is utilized for wine making. In the Fig 2 the fields of utilization in Turkey is seen.

37% of fresh grape production is using for raisin grape production that is concentrated in the Aegean region and 63% of it is seedless as cv Sultani grown in Aegean region and 37% of it is seeded grown all regions by different

cultivars, and with this figure Turkey is leads the world in raisin grapes grown specially for seedless market consumption.

Concentrated grape juice and some local products production are also important industries and range of it is about 30%. Wine grape percentage is about 3%. Turkey is a relatively small producer and exporter of wine by world standards.

There has been producing about 400.000 tons raisin yearly, the important raisin producer country in the world. 40-50% of world raisin production was made by Turkey. Seedless raisin production of Turkey with 250.000 tons per year, takes place in the second rank after USA in the world. The entire raisin seedless obtained Aegean region. Principle variety of raisin is Sultani. 50.000 – 70.000 tons of total seedless raisins to consume in domestic market (20-28%) and 180.000 – 210.000 tons is (72-80%) exported different countries.

**Fig 2. Grape utilize of Turkey**

## TURKEY GRAPE GERMLASM

In Anatolia, which is the country of the vine and wine, the viticulture goes back very old times. Vine culture began first in Asia Minor (Oraman 1972, Winkler at al 1974). In Anatolia there is very rich both of wild grape *Vitis vinifera* ssp. *sylvestris* and culture grape *Vitis vinifera* ssp. *Sativa* (Celik at al 1998). Wild grape can found almost all rivers valleys in all regions that has been searched for genotypic description, evaluation, and germplasm preservation.

Grape genetic potential of culture grape researched by a project of NCV consisting started at 1965 by Tekirdag VRI since than 1606 variety determined, and 1100 of them planted in the NCV for conversation and germplasm preservation. The identification of grape varieties by morphological and molecular description, micro vinification and evaluation of sensory properties, and evaluation of biotic and abiotic stress factors have been studying for last decade. The overall goal of the project is to strengthen the endowed with the National programmes on the vine genetic resources in Turkey (Celik at al 1998).

Plant breeding and germplasm conservation is performed by both the public and private sectors. Several public institutions are involved in plant breeding. Only three of them focus on the viticulture. Those are Tekirdag VRI, which is germplasm collection centre as NCV, and Manisa VRI which is raisin grape production centre, and Yalova Atatürk Central Horticulture Research Institute (YACHRI) which is studying on grape breeding and production practices. Some local genetic collection vineyards have been established by Universities and some other MARA institutions.

## ROOTSTOCKS AND VARIETIES

Standard grape varieties in production (including domestic and foreign varieties) Vinifera cultivars (*Vitis vinifera*) numbers of Turkey are around 80, the only limited area American-hybrid cultivars (*Vitis labrusca*) grown in north east Anatolia there has high precipitation and humidity.

Rootstocks that are more than 20 are using in Turkey but standard rootstocks that widely using are just 6 (41 B, 5 BB, 1103 P, 110 R, 99 R, Rupestris du Lot). Variety and rootstock number is dynamic (Celik et al 2005), that is being change by consumer preference, climate, soil characters and rootstock-scion relations.

By clone selection studies 37 standard grape varieties studied and 24 grape varieties (14 table grapes, 7 wine grapes, 2 multipurpose and 2 raisins) have been done. Selected clones protected by institutions of clones selected. Wine grape variety Kalecik karasi clones selected by University of Ankara Faculty of Agriculture Department of Horticulture (UAFADH). On the other hand some grape varieties introduced for different usage and adaptation studies have been done for different vineyard ecology in different locations.

New table grape breeding studies have been going on in YACHRI obtained seven new varieties. Tekirdag VRI obtained five new varieties and 4 new candidate varieties are under developing. On the other hand new variety breeding studies resistances to powdery mildew have been going on at Tekirdag VRI since 1986 (Celik at al 2005).

## PROPAGATION OF PLANTING MATERIAL

Production, supply and maintenance of healthy planting material are being organized by MARA. There are two tiers involved, namely, the national and individual nursery operator levels. The MARA is the national organization responsible for developing standards in vine health maintenance and product quality. Some MARA research and registration institutions have vine improvement organization whose role is to produce healthy cuttings as specified by MARA, for sale to nurseries. Privately owned nurseries propagate vines for sale to grape growers, preferably using cuttings from MARA institutions but also from commercial vineyards in times of short supply.

In recent years a substantial effort has been made at all levels of the industry to improve the health status of grapevine planting material in Turkey. Virus indexing of germplasm government standard cultivars collections using more sensitive techniques is almost complete and indexing of the MARA institutions source area vineyards, from which cuttings are produced and sold to nurseries, is being advanced.

MARA has jointly developed sanitation protocols for use by nurseries, in particular a hot water treatment (55°C, 45mins) of cuttings for the control of

crown gall and phytoplasmas. A quality assurance scheme has been under developing by MARA, which governs the health status and quality of planting material sold by participating nurseries. The types of planting material available are dormant cuttings, vines on own roots and vines grafted to rootstocks. Most planting material is purchased from nurseries and planted as vines with roots. Bench grafting using machines built for the purpose is the most widely used technique by nurseries.

After the 1980's there was an increase in the number of vines grafted to rootstocks. Nowadays 6 rootstocks are used as standard rootstock in the Turkey viticulture industries, primarily for easy propagate, drought tolerance, increased productivity, lime tolerance and easy propagate. Rapid expansion of the grape industries, mostly raisins and table grapes, have seen large increases in the number of vines produced each year but demand exceeded supply which led to shortages of propagating material. It was estimated that much of the propagating material used by nurseries came from commercial vineyards and hence had a doubtful health status and quality.

A large number of grape varieties are grown in Turkey. There are not clear statically data for area planted with each variety and tonnage utilized for drying, table grapes, concentrated fruit juice, and wine making. MARA institutions recommend each viticulture region some cultivars for each purpose.

The major raisin grape varieties are as seedless Sultani (as Yuvarlak Çekirdeksiz and Sultani Çekirdeksiz both of them seedless, multipurpose to utilize, and predominant varieties of plantings in around Manisa, Izmir and Denizli),

The major table grape varieties are Alphonse Lavallee, Besni, Buca Razakisi, Cardinal, Cavus, Gaydura Çekirdeksiz, Dökülgen, Gül üzümü, Hafizali, Hamburg Misketi, Isikli, Ipek, Italia, Kadın Parmagi, Karaburun Razakisi, Kabarcik, Kayircik, Kozak beyazi, Kozak siyahi, Mahrabasi, Müşküle, Osmanca, Pembe Gemre, Perlette, Razaki, Siyah Gemre, Tarsus beyazi, Yildiz, and new breded varieties as Ata sarisi, Baris üzümü, Ergin Çekirdeksiz, Uslu üzümü, Trakya Ilkeren, Yalova Incisi and Yalova Misketi.

The major wine grape varieties are Adakarasi, Alicante Bouchet, Beylerce, Bogazkere, Bornova Misketi, Burdur Dimriti, Cabernet Sauvignon, Cinsuat, Clairette, Carignan, Cal karasi, Dimrit, Dökülgen, Emir, Gamay, Granache, Hasandede, Horozkarasi, Kabarcik, Kalecik karasi, Karalahna, Kuntra, Merlot, Narince, Öküzgözü, Papaz karasi, Pinot Chardonnay, Pinot noir, Riesling, Semillon, Vasilaki and Yapincak (Anonymous 1990).

Total grafted plants were 4.024.664 during the 2003 period 17.8% of that was certificated. Plant propagation material importation and exportation of some Turkish varieties such as Sultani has been forbidden by Turkish government without some specification.

## SOIL PREPARATION AND PLANTING

Soil preparation involves applications are generally smoothing soil, adding organic material such as farm manure, green manure, and inorganic fertilizers as predominantly phosphorous and nitrogen. Ripping along the vine rows and sometimes of the entire site is used to break up compaction and impermeable layers and increase soil depth.

Immediately prior to planting the soil is cultivated. Planting is commonly carried out in late winter-early spring using dormant bare root vines. Some mechanical devices are available to assist with planting of vines. The recent introduction of container grown vines has enabled the planting season to continue through to mid-summer (Dec/Jan). The use of 'potted plants' to promote establishment of young vines has become widespread over the last 5 years.

Vine spacing varies slightly with grape types, age of vineyard and districts. Rows are mostly 2.5-3.5m wide with vines 1.5-2.5m apart. Spacing are commonly at the higher end of the range in more recent vineyards because of larger trellis designs, plus rootstocks and improved management practices contributing to greater vine vigor.

### **Trellis systems and pruning**

In Aegean region the most common trellis used for cv Sultani is a 6 or 8-wire large Y shaped trellis. The 6-wire High T trellis is far less popular. Both trellis designs have two cordon wires and vines are trained to a quadrilateral. Moveable foliage wires are not used nor hand positioning of shoots. Both trellis designs provide good separation of fruit and foliage. The Y trellis is preferred as it provides unobstructed access from both sides for harvesting and pre-harvest hand manipulation of bunches. The application of net covers is a little easier with the High T and cordon trellis. In all regions the most common trellis used for table and grape juice, and wine grape varieties is a 5-wire Bilateral Cordon and/or Guyot shaped trellis. This trellis designs are common using in Turkey viticulture especially new plantations.

Most varieties grown are spur pruned even in all regions for seeded table, juice and wine grape varieties. Sultani require cane pruning and there has been a recent shift to cane pruning of some table grape varieties for greater fruit yield. All pruning of grapes is done by hand. Pruning time is dormant season from November to end of March that is early in seaside and late in inland viticulture areas.

Hydrogen cyanamide (Dormex ®) is applied after pruning to enhance percent bud burst, promote uniform bud burst and advance bud burst time in the early season districts specially Mediterranean and Aegean regions. The use of hydrogen cyanamide is necessity for uniform and early bud burst in greenhouse early timetable grape production for the adequate result the dosage is between 1% and 5.0%.

## GRAPE LEAF PRODUCTION

The consumption of grape leaves have been using in our daily diets as an Anatolian grape culture. The nutrition value of grape leaves in literature as ingredients of 100 g eatable parts respectively 93.02 calorie, 5.6 g protein, 17.30 g carbohydrates, 11.00 g dietary fiber, 363.08 mg calcium, 91.02 mg phosphor, 11.10 mg ascorbic acid (Anonymous 2005). With this composition the grape leaves can comparable with many leafy vegetables and other horticultural crops. The grape leaf production is been a main aim in some locations as economic aspects that is being for producing of grape leaf pickling being done for table diet purpose. The most popular cultivars are Sultani and Narince grown around Tokat province. The young grape leaves from fruitfulness shoots of Sultani vineyards have been harvested before and/or after blooming (Agaoglu at al 1982 and Cangi at al 2005).

### Vine nutrition

Amendments and fertilizers are materials added to the soil to enhance soil quality and promote plant growth. Organic soil amendmets and fertilizers are used for these same purposes, and are materials specifically animal manures, composts, food processing wastes, and green manures. Inorganic fertilizers are also used for maintaining vine nutrition. Annual soil sample and dry matter analysis of petiole samples is commonly used for determining the nutrient requirements of grapevines. Some growers use soil and leaf analyses yearly but generally only every second or third year.

Most grape growers apply inorganic fertilizers spread to soil surface before the soil transaction at spring. Farm manure using is generally two or three year intervals. Broadcasting of fertilizer for incorporation by rain is uncommon and generally used only for particular fertilizer products. Annual fertilizer application rates for grape varieties in all regions are different as fertilizers and dosages. Foliar fertilizers are increasingly being used for the application for micro-nutrients (Zn, B, Mg, Mn).

## VINEYARD FLOOR MANAGEMENT AND IRRIGATION

Standard practice is a weed free strip along the vine row by two-soil transaction early spring and summer. There is sparse a permanent plant cover between rows. The inter-row plant cover is usually self-sown, regularly slashed and the under-vine strip maintained weed free with herbicides. Cultivation is generally practiced two or three times per year.

Irrigation is essential for profitable table grape production but grape production is possible in above 500 mm precipitation areas yearly. Drip irrigation is the standard technique used in newly planted modern vineyards. Furrow irrigation or under-vine sprinklers are not used because of limited water supplies and both methods of irrigation are found only in irrigation districts in some part of the viticulture regions. The springtime irrigation by solving snow

water is much more general practice in all regions of old vineyards without irrigation systems.

## PEST MANAGEMENT

Low chemical input is a characteristic of Turkey viticulture and over the last years there has been a shift to greater use of biological control methods. The viticulture industries are moving from routine to strategic spray programmes and this is most advanced in the table and raisin grape industry. There is also less spray uses in rural area viticulture in there generally having less humidity.

The success of strategic spray programmes is the accurate prediction of pest outbreaks and disease infection periods. This requires monitoring in the vineyard for the presence and development stage of a pest and recording weather data. MARA research institutes and extension services software package analyzes the weather data and vineyard observations to produce recommendations which assists grape growers to make spray management decisions.

The list of insects is very similar throughout the grape production regions of Turkey. *Lobesia botrana* Den.-Schiff. is a major pest of grape areas in all regions. A biological insecticide *Bacillus thuringiensis* is available for control of this pest. The pest mites are controlled organically by applications of wettable sulphur and several predatory mite species endemic in some vineyards. Growers maintain predatory mite populations by the careful selection of safe pesticides. *Lobesia botrana* and *Strophomorpha ctenotus* Desbr are the two significant pests of grapes in Turkey and require regular control to prevent serious damage.

Diseases are of far greater concern and impact on grape production throughout Turkey. Downy mildew (*Plasmopara viticola*), Botrytis (*Botrytis cinerea*) and anthracnose (*Elsinoe ampelina*) are the most damaging diseases of grapes in all regions. The standard spray programme for grape production involves regular applications of protectant fungicides with the timing determined by growth stage, weather forecasts and disease incidence the previous season. Copper oxychloride and mancozeb are the major fungicides used for downy mildew control. The eradicant fungicides metalaxyl, phosphorous acid, benalaxyl and oxadixyl are important for the post-infection control of downy mildew, particularly in seaside regions during the early growing season.

Powdery mildew (*Uncinula necator*) is very important in the wet and humid climate throughout in seaside regions, although it is less effective in dry climates especially inland regions. A programme of three or four sprays at seven to fourteen day intervals from bud burst is very effective in preventing powdery mildew. Wettable sulphur is commonly used early in the season, and then as the daytime temperatures exceed 30°C the demethylation inhibitor fungicides are used.



The spray programme for Botrytis is very specific and consists of two sprays during flowering, one spray before bunch closure, and one to three sprays during pre-harvest. To avoid resistance developing, particular attention is paid to using a fungicide from a different chemical group at alternate applications.

Control of anthracnose is possible only with regular applications of the pre-infection dithiocarbamate fungicides or dithianon for woolly bud and whenever new growth is present during wet weather. Once an outbreak of anthracnose has occurred it can take three to five years of good control practices to clean the disease from the vineyard. Fungicides used for anthracnose will also control Phomopsis (*Phomopsis viticola*) (Anonymous 1998).

## QUALITY MANAGEMENT

Gibberellic acid (GA) is routinely used with Sultani to thin flowers in the inflorescence and increase berry size not only table grape purpose but also raisin production. GA is not applied to seeded table grape varieties. Shoot tipping, shoot positioning, flower cluster thinning, cluster tinning, leaf tinning, and shoot topping have been using some areas but trunk and/or cane girdling is not used generally in Turkey table grape industry because the effectiveness of the technique in local climates is not known and growers generally have no experience. Net usage to protect fruit from hail and some bird damage are a recent innovation within the grape industry. The net covers are spread over the canopy of the vine just after fruit set till and of harvest.

## HARVESTING

All kind of grape crops is harvested by hand. This provides cost savings and is beneficial for maintaining fruit quality. In the modern raisin grape vineyards clusters are harvest to drying of the fruit on the shade lying on ground, on the trellis after the wetting with potasha solution (%5  $K_2CO_3$  and %1 olive oil). There is not any development for mechanical harvesting techniques for wine grapes and raisins have occurred in Turkey.

Table grapes are hand harvested, packed into cardboard cartons, cooled on farm and transported to market in refrigerated trucks. Most growers in table grape producing regions are pack in the vineyard as it is cheaper, the fruit is destined for the domestic market, and is easy to manage as only one line of fruit is being packed. Shed packing is used where there is some damage requiring extra work to clean the fruit, and when the fruit is destined for an export market, multiple lines are packed simultaneously, and for varieties sensitive to handling (Sultani and some other table grape varieties).

Polystyrene cartons and plastic bunch bags are also used for table grapes since the major retail supermarket chains.  $SO_2$  pads are used in west and south regions where fruit is consigned to the domestic and/or export market but are included in cartons of table grapes exported from table grape production areas.

### MARKETING

Table grapes are very popular fruit in Turkey. Annual per capita consumption is around 25 kg. Table grape production is 1800.000 tons, 160.000 tons of it is exported. 95% of its is cv Sultani at 2005 years production and exportation range grows up and newly breded table grape variety such as Yalova Incisi, and old varieties Perlette, Antep karasi, Hatun Parmagi (Fig 3) are the major export varieties. The exportation period is from beginning of July to end of January, and destination is Russia Federations, Ukranina, Germany, Saudi Arabia, Austria and Holland (Fig 4, Igeme 2005).

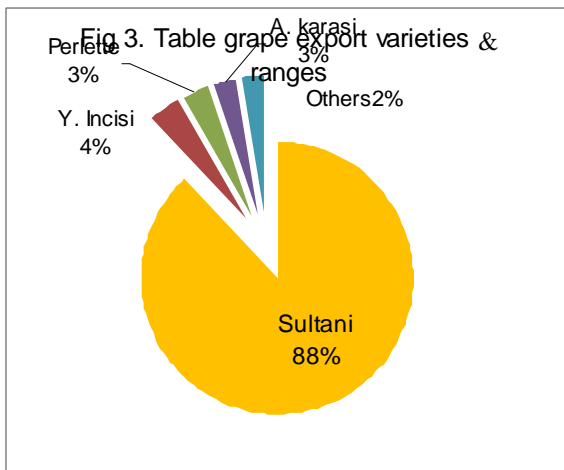
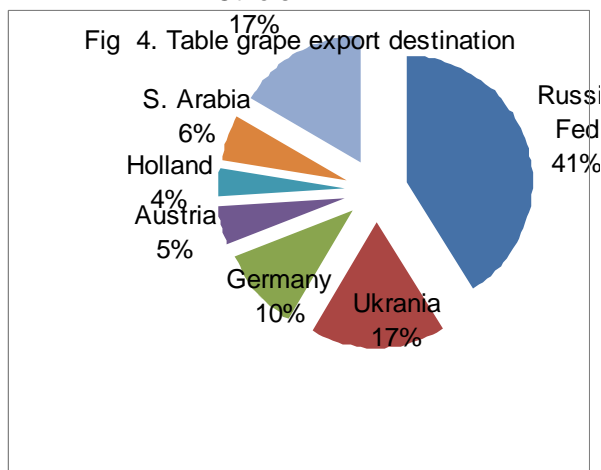


Table grapes are sold by two methods in Turkey. Firstly, the traditional practice of consigning fruit to a wholesale agent at the central market in each of the cities for sale on commission. More recently, an increasing amount of fruit is being sold directly to the retail supermarket chains under contract for an agreed price.

There are no table grape exports from districts across northern, eastern and partly middle Anatolia, as this production is middle or late season and commands a low price on the domestic market. Table grape exports are predominantly from Antalya, Trabzon, Izmir, Denizli, Hatay, Mersin, Bursa, Izmit and Isparta cities. In 2004-2005 periods the table grape exports reached a record high of 152.8 tons, the exportation period is from July to continue through to January (Igeme 2005).

### INDUSTRY POTENTIAL

The table grape industry has grown significantly in recent years, mostly in Aegean, and middle Anatolia regions and the potential exists for continued expansion in this regions. Water and land resources are available and support infrastructure is now well established. The potential exists to greatly increase export rate to Russia Federation and Asian countries. Same exporters in preparation for export continued growth of table grape exports to above



mentioned importer countries is likely to lead to industry growth.

There is the potential for further advances in low chemical use production practices and the development of additional biological control methods. Scope exists for greater adoption by grape growers of currently available integrated pest management practices and low chemical input viticulture. Significant improvements in vineyard efficiency and productivity will occur as a result of continued advances in table and raisin grape improvement and vineyard mechanization and production practices.

### **Research activities**

Research activities of viticulture are conducted by VRIs which are administered by the MARA, and horticulture departments of totally 23 agriculture faculties. There are mainly three institutes studied on viticulture in Turkey. Manisa VRI, conducted research studies basically on raisin and table grapes. Tekirdag VRI, study field basically on table and wine grapes, and YACHRI, the principle objective to promote basic and practical research programs on all horticultural crops. These institutes receive orders directly from the MARA. Institutional organization and study fields of institutes were breeding and genetics, agrotechnology, ampelography, plant protection, economy and statistics, postharvest physiology, processing technology (enology and chemistry), vine physiology, viticulture mechanization, extension and education and biotechnology.

## **REGULATIONS AND CERTIFICATION**

In Turkey the law contains rules and regulations of all producers, processors and handlers of organic commodities must adhere. As of 10.06.2005 date and Official Journal number 25841 that is accorded by EU order number 2092/91 of June 24, 1991 in order to qualify as organic, commodities must be produced on land where no prohibited substances have been applied for a minimum of three years immediately preceding harvest of the crop. The basis of these directions, special federations or unions for organic viticulture has made guiding rules for their practical application. Growers who choose to produce and market their crops as organic must register on a yearly basis.



**Fig 5. Logo of organic product of Turkey**

Annual registration fees are levied by the certification institution and in addition, a one-time initial registration fee is assessed. The state program is administered through the MARA. This act sets forth production standards and regulates all organic commodities on the national level. This registration program is administered through the MARA. The Organic Agriculture law currently recommends that growers be certified by certifying agents on an annual basis (Fig 5, Aksoy et al 2005).

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