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EFFECTS OF AIR POLLUTION AGENTS ON ORGANIC VITICULTURE

S. CELIK*, D. KOK

Department of Horticulture, Tekirdag Faculty of Agriculture, Trakya University, Tekirdag, Turkey
E-mail: salihcelik1@hotmail.com; demirkok@tu.tzf.edu.tr

Abstract. Grape production is carried out in almost all parts of Turkey. The area under cultivation for viticulture is 585 000 ha and the annual grape production is 3 500 000 t. The utilisation of the grapes is of various types: 23% in the fresh consumption, 37% in drying (raisins), 25% for boiled grape juice (concentrates) and 15% for wine making. Organic viticulture started in Turkey in 1984-1985 and was aimed at exporting the production to Europe. In 1999 grape production reached 7632.51 t. The purpose of this paper is to explain the effects of air pollution agents on organic viticulture. Effects of different metallic and non-metallic pollutants, dusts, gases on the internal and external damage resulting in necrosis in the plant parts were discussed. The absorption and penetration of the pollutants to leaves and their contribution on physiological and metabolic disorders are presented, too.

Keywords: are pollution agents, grape production.

AIMS AND BACKGROUND

World ecologically clean production started in the 1970's and, following the trend, ecological production was initiated after 1985 in Turkey[1,2]. Exports from Turkey of ecologically grown fresh production reached significant levels after 1990. A total of 3749.03 t of dried grapes grown ecologically from the total of 7632.51 t of dried grapes were exported in 1999 (Table 1).

In Turkey, a total of 3 500 000 t of grapes are produced from an area of 585 000 ha. The grapes produced are used in fresh consumption (23%), drying (37%), concentrates and juice (25%) and wine making (15%).

For ecologically clean production in addition to soil, water and chemical pollutants elements of air pollution are of significance. The air pollutants are dust, smoke, gases, odours and steam and the pollution originating from them occurs at a level posing risks to environment[3].

* For correspondence.

Table 1. State of ecological production, fresh and dried, in Turkey in 1999[1]

Product	Area (ha)	Production (t)	Exports (t)
	Dry and dried fruits		
Raisin	1988.96	7632.51	3749.03
Fig	2038.46	3562.68	918.03
Apricot	1526.17	5374.93	2031.96
Mulberry	25.00	7.00	0.00
Wild apricot	60.00	0.00	30.00
Dried plum	11.00	18.00	18.00
Cherry	47.63	383.00	12.12
Pear	165.18	473.24	35.82
Apple	1377.35	6262.94	5312.44
Pistacio nut	189.20	20.11	5.01
Almond	339.74	1618.76	5.00
Walnut	208.8	134.10	69.64
Pine nut	2073.00	129.8	21.80
Hazelnut	3744.85	2288.24	1095.44
Chestnut	9.10	0.00	0.00
Tomato	152.33	5324.49	796.20
Bean	766.57	526.23	196.78
Total	14723.34	33756.03	14297.27
	Fruits (fresh)		
Lemon	1.00	30.00	0.00
Tangerine	9.00	616.00	0.00
Plum	147.70	1969.59	365.21
Peach	57.7	2450.00	62.00
Sour cherry	144.50	752.61	265.85
Olive*	198.40*	25135.00*	16.38
Apricot	1526.17	5374.93	2031.96
Raspberry	52.64	502.00	43.70
Strawberry	158.90	875.44	370.12
Total	2096.9	12570.57	3155.22
	Vegetables		
Pepper	31.00	910.51	151.00
Squash	1.20	39.53	10.00
Leek	2.90	0.00	0.00
Onion	4.10	224.18	26.60
Garlic	7.28	0.00	0.00
Parsley	1.00	5.00	0.00
Spinach	18.00	0.00	0.00
Total	65.48	1179.22	187.6

Dust damage to the grapevine. The most important of all the dusts originating from factory chimneys or various other sources is the cement dust. Also fluorine and other Pb particles, oxides of Mg and Fe, dusts from bricks and clay roofing tiles, dusts from main and side roads accumulate on the both sides of vine leaves thereby disrupting the respiration and photosynthesis. These dusts are not only harmful to the leaves themselves but also act as a medium for development of fungal damaging the fruit clusters. Despite the fact that the negative effects of the dusts can be neutralised by some chemicals they are not allowed in the organic production of grapes.

Pollution of SO_2 and Fe in the air and possible risks to grapevines. Thresholds of the SO_2 and fluorine pollution in the air are 200-600 ppm and 0.5-20.0 ppm, respectively, as above these limits grapevines are damaged[4]. The main sources of sulphur dioxide are coal and fuel oil. In addition, SO_3 and H_2S are also important pollutants. The SO_3 is obtained during the production of H_2SO_4. The H_2S is released from the processing of natural gas and from the sewage processing units[5]. Fluorine alternatively is released from the factories of aluminum, bricks and ceramics, especially from those processing clay as in the latter two production systems. HF, a compound of F, is released to the atmosphere during the production of phosphate fertilisers. From the above mentioned pollutants when the level of SO_2 and Fe reaches 500 ppm and 10-20 ppm, respectively, damages are observed on the grapevine leaves and necroses become apparent. The grapevines are more sensitive to F than to SO_2. The necrosis caused by SO_2 pollution appears in the form of interveinal and irregular colour change. Leaves start to drop at higher levels of pollution. The necrosis caused by the F is apparent at the edge sides of leaves[4].

The necrosis is caused by the SO_2 which enters through the stomata and affects the cell processes. Aften the entry through the stomata, SO_2 accumulates in the intercellular spaces, then through the connection with cells in the palisade parenchyma reaches the upper epidermis resulting in the necrosis. Absorption of SO_2 by water is higher in comparison to CO_2. Due to the higher solubility of SO_2 in water, necroses in tissues originating from SO_2 appear[6,7].

Effects of pollutants on photosynthesis, transpiration and respiration. Photosynthesis and transpiration are halted by sulphur dioxide and other gases entering inside the leaves and dusts covering the both sides of the leaves. SO_2 causes reduction in CO_2 fixation by changing the size of thylokoidal plates within the chloroplasts resulting in the disruption of the coordination of the enzymes responsible for CO_2 fixation.

Fluorine compounds become effective in halting the photosynthesis by binding the cations of Ca and Mg which appear as necrosis in the leaves. Pol-

lutant gases negatively affect respiration by inhibiting the enzymes at the glycosis stage[6].

Sensitivity of the grapevine to the air pollutants. In general, the grapevine is sensitive to SO_2 and F and other pollutant dusts. In fact, the sensitivity is higher in organic agriculture due to the fact that the use of chemicals to protect the plants is not allowed. The sensitivity of grapevine varies depending on the development stage and physiological status of the plant. While SO_2 sensitivity is low at the beginning of the vegetation period, an increase initiates following veraison. In comparison to young leaves, mature ones are more sensitive.

Sensitivity of the grapevines to the pollutants increases with increasing metabolic activities due to the opening of the stomata induced by light, temperature and humidity. Combinations and concentrations of the pollutant gases determine the damage level. The combinations of SO_2 with NO_2 and SO_2 with HF pose serious risks[8].

CONCLUSIONS

In order to protect vineyards from pollutant gases, they should be established in locations away from the pollution sources. Occasional sprinkling of water over the grapevines in the vineyards established in the areas of pollution must be realised. This is especially helpful in the vineyards established by the main roads or highway.

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