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GOOD AGRICULTURAL PRACTICES (GAP) FOR GREENHOUSE SOILLESS TOMATO GROWING

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Abstract

Tomatoes have become one of the most popular and widely grown vegetables around the world. Nowadays, tomato cultivation with soilless agriculture has gained popularity. Sustainability of good farming practices seems to be quite high compared to other agricultural production systems. This research was carried out in the Serik District of Antalya to demonstrate the effectiveness of good agriculture practices in the greenhouse cultivation of soilless tomatoes. The varieties taken in the experiment were Gülpembe grafted on Beaufort rootstock. In the study, pesticide residue levels were determined in fruit extracts as well as analyses for water. Extraction steps and all analyses were carried out at the Proanaliz Food Control Laboratory. High-precision analytical instruments such as LC-MS / MS and GC-MS were used for pesticides residues. A total of 1025 pesticide active substances were analysed in LC-MS / MS and 117 pesticide active substances in GC-MS in fruit extracts. In this research carried out in 2015 and 2016, samples of both years were not found to be detectable to the tolerance values of Turkish Food Codex (TFC).

Key words: *tomatoes, GAP, pesticides, residue, Serik-Antalya.*

INTRODUCTION

Tomato is one of the most important vegetables produced in the world. Its homeland is the South America Countries where Peru and Ecuador are located. It was first cultivated by Mexicans and after the discovery of New World, it spread from America to Europe and the other continents. In Turkey, it was started to be grown in the early 1900s in Adana.
On the species basis, the tomato that takes the first place in vegetable cultivation is cultivated both open field and in greenhouses.
In Turkey 12,615,000 tons of tomatoes are produced, of which 8,170,000 tons are table tomatoes, 4,445,000 tons are for sauce production (TÜİK, 2016).
Greenhouse production has an important place in our agricultural sector due to its high efficiency and income from the unit side and ,at the same time, providing a regular use of labor force throughout the year by spreading vegetable production to all seasons of the year. In greenhouse production, tomato takes the first place.
Approximately 27% (3,399,100 tons) of our total tomato production is obtained from the greenhouse and contribution of this specie in greenhouse production is 53.5%. 77.6% of greenhouse tomato production is originating from the greenhouse systems in the Mediterranean Region.
Antalya provides 62.5% of this production. Greenhouse tomato production is practiced in 259,709 da areas. 5.6% of production area consists of low plastic tunnel (14,644 da), 6.1% high plastic tunnel (15,765 da), 68.5% plastic greenhouse (177,937 da) and 19.8% glass greenhouse areas (51,363 da). Most of the production is obtained from plastic greenhouses (71%) and glasshouses (21%).
The amount of greenhouse tomato production in Turkey has increased prominently in recent

years due to increase of production area, usage of quality seed and modern agricultural techniques. (TÜİK, 2016).

Soilless production in Turkey besides having a history of about 20 years, is rapidly becoming widespread due to providing earliness, productivity and quality increase.

Soilless agriculture is generally widespread in the Mediterranean and Aegean Regions and 74% of total production is made in Antalya and İzmir provinces.

The most important specie in soilless agriculture is tomato (Toprak and Gül, 2013; Kandemir et al., 2015).

Soilless agriculture is based on the principle that water and nutrients required for plant growth are supplied to the root in the required amount and it is split up into environmental and aquatic culture.

In environmental culture, plants are grown in organic or inorganic environments with irrigation nutrition solution. In aquatic culture, plants are grown in water containing nutrients.

Food safety and quality are among the most important issues in recent years.

The residues of the pesticides have become the fear of those who wants healthy foods. The consumption of pesticides in the Mediterranean and Aegean regions, where greenhouses are common, is close to two-thirds of the country's total.

On the other hand, when we think features of pesticides we consume, the vast majority have significant risks for human and environmental health.

Residue analyzes which are made more frequently than the past show that pesticide contamination in our products is reduced, but even in our elite products exported to EU countries, we encounter parcels which are not suitable for pesticide residue limits.

Besides all these problems, a number of new legal regulations to solve problems caused by pesticides, the prohibition of some risky pesticides, the introduction of a prescription system, and some other planned regulatory developments are seen as promising developments (Anonymous, 2017a).

Another of these promising developments, which has a great importance, is undoubtedly good agricultural practices based on certificated production. Antalya has an important position in vegetable, especially tomato growing. In such places where the potential is high, it is necessary to speed up the works for good agricultural practices.

In this research, it is aimed to determine pesticide residues obtained from a greenhouse, in which are grown tomatoes with good agricultural practices, in hydroponic system in Antalya.

MATERIALS AND METHODS

Materials

Materials in this research are varieties of truss tomato called 'Gülpembe F1' grafted onto rootstock. This kind of plant is in the category of pitted tomato, the shortness of internode is short, early and highly productive. There are 4-5 fruits in the bunch, they are small sliced, their taste and aroma are so good, colour is bright pink, weight 250 g, flesh is hard and its shelf life is ideal.

Pesticides given in Table 1 and Table 2 are searched in the examples of tomatoes, which are the materials. All extraction studies and residue analysis of the examples made in Proanaliz Food Control Laboratory.

Table 1.Active substances examined in tomatoes examples on LC-MS/MS device

2,4,5-T; 2,4-D; 3,4,5 trimethacarb; Abamectin; Acephate; Acequinocyl; Acetamiprid; Acetochlor; Acibenzolar-S-Methyl; Aclonifen; Acrinathrin; Alachlor; Aldicarb; Aldicarb-Sulfone; Aldicarb-Sulfoxide; Allethrin; Ametoctradin; Ametryn; Amidosulfuron; Amisulbrom; Amitraz; Amitrole; Anilazine; Anilofos; Aramite; Asulam; Atrazine; Azamethiphos; Azimsulfuron; Azinphos-Ethyl; Azinphos-Methyl; Aziprotryne; Azoconazole; Azocyclotin; Azoxystrobin; Barban; Beflubutamid; Benalaxyl; Bendiocarb; Benfuracarb; Benomyl; Bensulfuron methyl; Bentazone; Benthiovalicarb Isopropyl; Benzoximate; Bifenox; Bifentrin; Binapacryl; Bioresmethrin; Bispyribac; Bitertanol; Boscalid; Bromacil; Bromophos methyl; Bromophos-Ethyl; Bromoxynl; Bromuconazole; Bupirimate; Buprofezine; Butafenacil; Butocarboxim; Butocarboxim-sulfone; Butocarboxim-sulfoxide; Butoxycarboxim; Butralin; Buturon; Butylate; Cadusafos; Campheclor; Campheclor-methyl; Campheclor-oxon; Campheclor-oxon-sulfone; Campheclor-oxon-sulfoxide; Campheclor-sulfone; Campheclor-sulfoxide; Carbaryl; Carbendazim; Carbofuran; Carbosulfan; Carboxin; Carfentrazone-Ethyl; Chlorantraniliprole; Chlorbromuron; Chlorbufam; Chlorfenvinphos; Chlorfluazuron; Chloridazon; Chlormequat chloride; Chlorotoluron; Chloroxuron; Chlorpropham; Chlorpyrifos; Chlorpyrifos-Methyl;

Chlorsulfuron; Chlortal-dimethyl; Chlorthiamid; Chromafenozide, Cinidon-ethyl; Clethodim; Clethodim Iminsulfone; Clethodim Iminsulfoxide; Clethodim Sulfoxide; Climbazole; Clodinafop-proparpyl ester; Clofentezine; Clomazone; Cloquintocet-methylhexyl ester; Clothianidin; Coumaphos; Crimidine; Cyanazine; Cyanofenphos; Cyazofamid; Cyclanilide; Cycloate; Cycloloxydim; Cyflufenamid; Cyhalofop; Cyhalofop butyl; Cyhalofop diacid; Cyhexatin; Cymoxanil; Cyproconazole; Cyprodinil; Cyromazine; Daminozide; Dazomet; Demeton(O+S); Demeton-S-Methyl; Demeton-S-Methyl-Sulfone; Demeton-S-Methyl-Sulfoxide; Desmedipham; Desmetryn; Diafenthiuron; Dialifos; Di-Allate; Diazinon; Dichlofenthion; Dichlofluanid; Dichlorprop; Dichlorvos (DDVP); Diclobutrazol; Diclofop-Methyl; Dicloran; Dicrotophos; Diethofencarb; Difenoconazole; Diflubenzuron; Diflufenican; Dimefox; Dimethachlor; Dimethenamid; Dimethoate; Dimethomorph; Dimetilan; Dimoxystrobin; Diniconazole; Dinitramine; Dinocap; Dinoseb; Dinoterb; Dioxacarb; Diphenamid; Dipropetryn; Disulfoton; Disulfoton Sulfone; Disulfoton Sulfoxide; Ditalimfos; Dithianon; Diuron; DNOC; Dodine; E-Fenpyroxymate; Emamectin; Benzoate; Endosulfan Sulfate; Epichlorohydrin; EPN; Epoxiconazole; EPTC; Esfenvalerate; Etaconazole; Ethalfluralin; Ethametsulfuron Methyl; Ethiofencarb; Ethiofencarb-sulfone; Ethiofencarb-sulfoxide; Ethion; Ethiprole; Ethirimol; Ethofenprox; Ethofumesate; Ethoprophos; Ethoxyquin; Ethoxysulfuron; Ethylene thiourea; Etoxazole, Etridiazole; Etrimfos; Famoxadone; Famphur, Fenamidone; Fenamiphos; Fenarimol; Fenazaquin; Fenbuconazole; Fenbutatin oxide; Fenhexamid; Fenitrothion; Fenobucarb; Fenoxyaprop-P-ethyl; Fenoxycarb; Fenpiclonil; Fenpropathrin; Fenpropidin; Fenpropimorph; Fensulfothion; Fenthion; Fenthion Oxon; Fenthion Oxon Sulfone; Fenthion Oxon Sulfoxide; Fenthion-Sulfone; Fenthion-Sulfoxide; Fentin acetate; Fentin Hydroxide; Fenvalerate; Fipronil; Flamprop-M-Isopropyl; Flazasulfuron; Flonicamid; Florasulam; Fluazifop-p-butyl; Fluazinam; Flubendiamide; Flubenzimine; Flucycloxuron; Flucythrinate; Fludioxonil; Flufenacet; Flufenoxuron; Flumioxazine; Fluometuron; Fluopicolide; Fluopyram; Fluorochloridone; Fluoroglycofen Ethyl; Fluoxastrobin; Flupyrsulfuron Methyl; Fluquinconazole; Fluroxypyr; Flurtamone; Flusilazole; Flutolanil; Fluxapyroxad; Fomesafen; Fonofos; Foramsulfuron; Forchlorfenuron; Formetanate; Formetanate hydrochloride; Fosthiazate; Fuberidazole; Furalaxyl; Furathiocarb; Halfenprox; Halosulfuron Methyl; Haloxyfop-2-Ethoxy-Ethyl; Heptanafos; Hexaconazole; Hexaflumuron; Hexazinone; Hexythiazox; Imazalil; Imazamox; Imazapic; Imazapyr; Imazaquin; Imazethapyr; Imazosulfuron, Imibenconazole; Imidachloprid; Indoxacarb; Iodosulfuron methyl sodium; Ioxynil; Ipconazole; Iprobenfos; Iprodione; Iprovalicarb; Isazofos; Isocarbofos; Isoprocarb; Isoproturon; Isoxaben; Isoxadifen Ethyl; Isoxaflutole; Isoxathion; Kinetin; Kresoxim-methyl; Lenacil; Linuron; Lufenuron; Malaoxon; Malathion; Maleic Hydrazide; Mandipropamide; MCPA; Mecarbam; Mecoprop (MCPP); Mecoprop-P (MCPP-P); Mepanipyrim; Mephosfolan; Mepronil; Meptyldinocap; Mesosulfuron Methyl; Mesotrione; Metaflumizone; Metalaxyl; Metalaxyl M; Metamitron; Metazachlor; Metconazole; Methabenzthiazuron; Methacrifos; Methamidophos; Methidathion; Methiocarb; Methiocarb sulfone; Methiocarb sulfoxide; Methomyl; Methomyl oxime; Methomyl Sulfone; Methoxyfenozide; Metobromuron; Metolachlor; Metolcarb; Metosulam; Metoxuron; Metribuzin; Metrofenone; Metsulfuron-Methyl; Mevinphos; Milbemectin A3; Milbemectin A4; Molinate; Monocrotophos; Monolinuron; Monuron; Myclobutanil; Naled (Dibrom); Naphthalene Acetamide (NAD); Napropamide; Napthol-1; Neburon; Nicosulfuron; Nitenpyram; Norfluazuron; Novaluron; Nuarimol; Ofurace; Omethoate; Orthosulfamuron; Oxadiazon; Oxadixyl; Oxamyl; Oxasulfuron; Oxycarboxin; Oxyfluorfen; Paclobutrazol; Paraoxon Ethyl; Paraoxon Methyl; Parathion-Ethyl; Parathion-Methyl; Pebulate; Penconazole; Pencycuron; Pendimethalin; Penoxsulam; Permethrin; Pethoxamid; Phenmedipham; Phenothrin; Phentoate; Phorate; Phorate Sulfone; Phosalone; Phosmet; Phosmet oxon; Phosphamidon; Phoxim; Picolinafen; Picoxystrobin; Pinoxaden; Pirimicarb; Pirimicarb Desmethyl; Pirimicarb Desmethyl Formamido; Pirimiphos-Ethyl; Pirimiphos-Methyl; Prochloraz; Profenofos; Profoxydim; Profoxydim lithium; Prohexadione calcium; Promecarb; Promethryn; Propachlor; Propanil; Propaquizafop; Propargite; Propazine; Propetamphos; Propham; Propiconazole; Propisochlor; Propoxur; Propoxycarbazone sodium; Propyzamide; Proquinazid; Prosulfocarb; Prosulfuron; Prothioconazole; Prothiophos; Pymetrozine; Pyraclostrobin; Pyraflufen; Pyraflufen ethyl; Pyrasulfotole; Pyrazophos; Pyrethrins; Pyridaben; Pyridaly; Pyridaphenthion; Pyridate; Pyrifenox; Pyrimethanil; Pyriproxyfen; Quaizalofop_P_Ethyl; Quinalphos; Quinclorac; Quinmerac; Quinoxyfen; Resmethrin; Rimsulfuron; Rotenone; Sethoxydim; Silthiofam; Simazine; Spinetoram; Spinosad; Spirodiclofen; Spiromesifen; Spirotetramat; Spirotetramat-Enol; Spirotetramat-Enol-Glucoside; Spirotetramat-Ketohydroxy; Spirotetramat-Monohydroxy; Spiroxamine; Sulcotrione; Sulfosulfuron, Sulfotep; Sulprofos; Tebuconazole; Tebufenozide; Tebufenpyrad; Tebupirimfos; Teflubenzuron; Tembotrione; Temephos; TEPP(O.O-TEPP); Tepraloxydim; Terbufos; Terbumeton; Terbuthylazine; Terbutryn; Tetraconazole; Tetramethrin; Thiabendazole; Thiacloprid; Thiamethoxam; Thidiazuron; Thifensulfuron-methyl; Thiobencarb; Thiodicarb; Thiofanox; Thiofanox Sulfone; Thiofanox Sulfoxide; Thiophanate-methyl; Tolclofos-Methyl; Tolfenpyrad; Topramezone; Tralkoxydim; Triadimefon; Tri-allate; Triasulfuron; Triazophos; Tribenuron-Methyl; Trichlorfon; Trichloronat; Triclopyr; Tricyclazole; Tridemorph; Triethyl Phosphate; Trifloxystrobin; Triflumizole; Triflumuron; Triflusulfuron Methyl; Triforine; Trinexapac Ethyl; Triticonazole; Tritosulfuron; Uniconazole; Vamidothion; Zoxamide

Table 2.Active substances examined in tomatoes examples on GC-MSD device

2,4-5T; 4,4 Dichlorobenzophenone; Aldrin (HHDN); Alpha-Endosulfan; Alphamethrin (cypermethrin); Beta-Endosulfan; Bromopropylate; Captafol; Captan; Chlorfenson; Chlorobenzilate; Chlorothalonil; Cycloate; Cyfluthrin; Cypermethrin; Dazomet; DDD-2.4'-; DDD-4.4'-; DDE-2.4'-; DDE-4.4'-; DDT-2.4'-; DDT-4.4'-; Deltamethrin; Dicamba; Dicofol; Dinobuton; Diphenylamine; Endosulfan-sulfate; Endrin; Esfenvalerate; Ethalfluralin; Fenvelarate; Folpet; Formothion; Gamma-HCH (Lindane); Hexachlorobenzene; Iprodione; IS-TPP; Lambda-Cyhalothrin;

Methoxychlor; Nitrofen; Nitrothal-isopropyl; Permethrin; Phenmedipham; Procymidone; Quintozene (penta chloro nitro benzene); Qunomethionate; Tau-fluvalinate; Tecnazene; Tetradiphon; Tetrasul; Thiometon; Tolyfluanid; Trifluralin; Vinclozolin; α (alpha)- HCH; β(beta) – HCH; 2-chloraniline; 3-chloraniline; 4-chloraniline; Aminocarb; Diclobenil; Biphenyl; Propamocarb; Carbofuran -3-hydroxy; Nitrapyrin; Chloroneb; 2-phenyl phenol; Benfluralin; BHC; Dioxathion; Profluralin; Fluchloralin; Terbacil; HCH(delta); Tefluthrin; Bromociclen; Pentacholoaniline; Flurprimidol; Chlorzolinate; Transfluthrın; Fenchlorphos; Diphenylmercury; Dinoseb acetate; Heptachlor endo-epoxide(trans isomer); Heptachlor endo-epoxide(cis isomer); S-Metolachlor; Fenson; Isodrin; Iodofenphos; Isofenphos; Chlorbenside; Haloxyfop-R-methyl; Tetrachlorvinphos; Chlordane-cis-alpha; Flutriafol; Diethatyl-ethyl; Dieldrin; Perthane; Chlorfenapyr; Carbophenothion, Tributyl Phosphote; Chlordane-trans-gamma; IS-TPP; Bifenazate; Mefenpyr-diethyl; Leptophos; Heptachlor; Mirex; Dimethipin; Cyanaphos; Chlorthion; Methoprene; Chlordecone; Oxadiargly; Fluotrimazole; Lactofen

Methods

All the solvents and chemicals (water, acetonitrile, methanol, formic acid, acetic acid and ammonium formate) used as mobile phases in example extractions are chosen in accordance to a profound quality. Pesticide standards are prepared at least a 90% rate of purity. Extractions and clearance of the examples are generalized in accordance with AOAC (International Official Methods of Analysis) methods (Lehotay, 2007). Some chromatographic conditions for LC-MS /MS and GC-MS devices are given in Table 3 and Table 4.

Table 3. Chromatographic Working Conditions of LC-MS/MS

LC-MS/MS	Agilent 6420			
Mobile Phase A	5 mM Amonium Formate&Water + Acetonitrile			
Mobile Phase A	Pure methanol			
Column	Poroshell 120 SB-C18 (3.0 x 100 mm 2.7 Micron)			
Injection Volume	10 µl			
Flow Rate	0.6 ml/min			
MS Gas Temperature	300°C			
Sheat Gas Temperature	350°C			
The Column Oven	35°C			
Pump Gradient Program				
	Time	Mobile phase A %	Mobile phase B %	Flow rate ml/min
	0:00	80	20	0.6
	0:00	80	20	0.6
	0:20	80	20	0.6
	1:50	30	70	0.6
	6:00	5	95	0.6
	7:50	5	95	0.6
	7:60	80	20	0.6
	10:00	80	20	0.6

Table 4. Chromatographic Working Conditions of GC/MS

GC-MS	Agilent 5975
Carrier gases	Helium
Column	HP-5MS 30 m × 250 µm × 250 µm × 0.25 µm
Injection Volume	5 µl
Flow Rate	2.4 ml/min
Duration of Injection	18.5 min
MS Gas Temperature	300°C
Sheat Gas Temperature	350°C
The Column Oven	35°C
Inlet temperature program	

Start	Rate of increase (°C/min)	Temperature (°C)	Retention Time (RT) (min)
1	0	55	0.21
2	600	325	18.5

The Column Oven temperature program			
Start	Rate of increase (°C/min)	Temperature (°C)	Retention Time (RT) (min)
1	0	50	0
2	50	150	0
3	20	230	1
4	8	290	3
5	0	290	18.5

RESULTS AND DISCUSSIONS

Residue quantities obtained from the research were evaluated as average of 3 repetitions in each sample according to Turkish Food Codex (TFC) Regulation on Maximum Residue Limits of Pesticides (Turkish Official Gazette No 21.01.2011-27822; Notification No: 2011/2). The TFC residue limits of each pesticide sample are indicated separately in the tables presented. In residue limits determined by using high-precision analytical instruments such as GC-MS and LC-MS/MS, in tomatoes samples analyses of total 1025 pesticide active ingredients were made in LC-MS/MS instrument and 117 pesticide active ingredients in GC-MS instrument. In this research carried out between 2015 and 2016, detectable levels of the residues were not found in the samples of these two years.

The use of conscious and controlled pesticides in our agricultural production, especially in exported products, is very important to avoid the residual problem. The use of pesticides should be very conscious and controlled to ensure the safety of our country's people and to protect our environment and our foreign trade. In the EU and the US, priority should be given to low-risk or environmentally friendly pesticides that have the potential to affect the environment and health as little as possible. In Turkey, environmentally friendly pesticides are not given priority to licensing and supporting of their consumption (Tiryaki, 2016).

Not having pesticide residues of agricultural products is very important in domestic consumption and foreign trade. Because the communication is very fast. In Rapid Alert System for Food and Feed (RASFF) of the EU is notified of which are not suitable due to pesticide residues. The EU has published products and origins on the internet which are not suitable for residues in the EU products through the Rapid Alarm System (Anonymous, 2017b). The eligibility status of the products exported to EU countries is shown in Table 5.

As seen in Table 5, the number of lots that are not suitable for the standards of foods and feedstuffs sent to the EU from Turkey and it rose even further in 2015.

Turkey is in the second place among 146 countries from the point of the number of non-eligible parties. Also, in a research we carried out, 203 pesticide residues in tomato, pepper and aubergine vegetables samples collected from local markets and markets in Konya were analyzed.

Extraction of vegetable samples was carried out in the laboratories of Selçuk University Departments of Agronomy and Horticulture, residue analyzes were made in the laboratories of Ministry of Food, Agriculture and Livestock, İzmir Provincial Control Laboratory Directorate's Organic Farming Products and Residue Analysis Laboratory with LC-MS/MS and GC-MS devices. Findings obtained from the study show that oxamyl (Tolerance value of Turkish Food Codex (TFC); 10 µg/kg), which is totally forbidden to use in a tomato sample, has a value of about 7 times, two different pesticides (112 µg/kg Ethion and 75 µg/kg Triazophos) were found in a pepper sample , in another pepper case, it was determined that 120 µg/kg Benomyl was above the tolerance value of 100 µg/kg of TFC.

In the 10 aubergine samples taken for the experiment, it was determined that the level of oxamyl which is prohibited to use was about 11 times, which means, 107 µg/kg. Besides, Imidiacloprid (TFC tolerance value; 20 µg/kg) was found respectively at 49, 190 and 64 µg/kg in 3 different aubergines.

Table 5. 2013-2015 notifications by country of origin

Country	Year 2013	Year 2014	Year 2015
China	436	417	388
Turkey	226	200	282
India	257	199	276
Spain	185	169	159
France	120	104	120
Poland	164	131	118
Germany	95	135	117
Italy	105	89	117
Netherlands	103	114	94
Brazil	187	109	91
United States	102	164	87
Vietnam	76	124	85
Egypt	49	55	78
Thailand	88	90	71
Iran	21	54	61
Belgium	60	75	58
United Kingdom	55	50	56
Denmark	19	28	27
Sweden	45	7	25
Argentina	76	40	22

In the same way, Osman et al. (2010) also investigated 23 different pesticide residues from GC-MS in 160 local vegetables collected from 4 large supermarkets in Al-Qassim district of Saudi Arabia (2010). According to the results, in 89 of 160 samples were found pesticide residues, in 53 it was determined that obtained values was above the Maximum Residue Levels (MRL). In this research, pesticide residues was found in 17 of 30 vegetable samples.

The most common pesticides in vegetables were respectively Carbaryl, Biphenyl and Carbofuran.

Zengin and Karaca (2017), investigated on 249 different pesticides residue levels in tomatoes samples which taken from greenhouse in Uşak province in 2015-2016 growing seasons. According to the results, 63% of taken 60 tomato samples had no detectable residues. In 37% of tomato samples detected pesticide residue, none of this pesticides exceeded the maximum residue limits given in Turkish Food Codex. Imidacloprid was the most common pesticide among detected pesticides.

Pesticide residues obtained from 11 of 16 pumpkin samples, 7 of 12 carrot and green pepper samples, 6 of 11 cucumber samples, 5 of 12 eggplant samples, 7 of 11 spinach samples, 6 of 11 lettuce samples, 4 of 11 tomato samples were reported to be above MRL.

The highest pesticide residues were found respectively in lettuce (Ethiofencarb, 7.648 mg/kg), tomato (Tolclofos-methyl, 7.312 mg/kg), pumpkin (Chlropyrifos, 6.207 mg/kg), carrot (Heptanophos, 3.267 mg/kg), green pepper (Carbaryl, 2.228 mg/kg) and aubergine (Carbaryl, 1.917 mg/kg). These findings point that it's necesssary pesticide residues in vegetables grown in greenhouses to be examined for the protection of public health.

Duru et al. (2013), examined pesticide residues in 33 of 145 fruit and vegetable samples which are sampled in İzmir in 2007-2008. In 74 of 145 analyzed samples was not found residue. In 30 samples were found residues below tolerance, in only 7 samples were found residues over-tolerance. The highest residues were found in the fresh grape, raisins and tomato samples.

Tatlı (2006) investigated the residue levels of pesticides commonly used in fresh fruit and vegetable samples (strawberry, tomatoes, artichoke, table figs, cherry, potatoes, peach, table grapes, olive) collected in the Aegean region and from human consumption areas and in the cultivation of dried food samples. In these samples, 50 pesticides with organic chlorine, organophosphorus insecticides and synthetic pyrethroids, strobulin and benzimidazole group were selected from fungicides. In tomato, artichoke, table figs, dried figs and potato samples were not found any detectable pesticide residues. And in the samples of other products at least one pesticide residue was found at detectable levels.

Residue quantities in the samples with residuals were evaluated according to Turkish Food Codex and EU MRLs and pesticide residues were found over 2.34% tolerance in agricultural products.

CONCLUSIONS

The usage of pesticides and the fate of this usage are always on the agenda in today's world, and it is also likely to remain like that. Because, as intensive pesticide use in traditional agriculture, there are controlled pesticide use in "Good Agricultural Practices" and natural pesticide use in organic agriculture. In many studies, toxicological risks and environmental risks of pesticide residues to human health have been researched as a result of excessive and unconscious pesticide use (Tiryaki, 2016). In this context, Good Agricultural Practices involves agricultural techniques which are environmentally sensitive, do not harm human and animal health, aim to protect natural resources, and ensure traceability and food safety.

With such production techniques, socially viable, economically profitable and sustainable agricultural production is targeted. Therefore, Turkey has the support of the Ministry of Food, Agriculture and Livestock to encourage the transition to good agricultural practices. When compared to conventional agriculture, these can be promising techniques for achieving healthy and reliable food.

REFERENCES

Anonymous 2017a. http://www.zmo.org.tr/resimler/ekler/52cf38361a20908_ek.pdf (accessed, March 25 2017).

Anonymous 2017b. https://ec.europa.eu/food/sites/food/files/safety/docs/rasff_annual_report_2015.pdf (accessed, March 25 2017).

Duru A.U., Örnek H., Burçak A.A., 2013. İzmir İli'nde satışa sunulan bazı meyve ve sebzelerde pestisit kalıntılarının araştırılması. I. Bitki Koruma Ürünleri ve Makinaları Kongresi, Bitki Koruma Ürünleri (Cilt I, Pestisitler), Bildiriler Kitabı: 59-69, 2-5.

Kandemir D., Kurtar E.S., Demirsoy M., 2015. Türkiye Sebze Fidesi Üretimindeki Son Gelişmeler, TÜRKTOB Türkiye Tohumcular Birliği Dergisi, No:4, 4.

Lehotay S.J., 2007. Determination of pesticide residues in foods by acetonitrile extraction and partitioning with magnesium sulfate: collaborative study, Journal of AOAC International, 2007 Mar-Apr, 90(2):485-520.

Tiryaki O., 2016. Türkiye'de yapılan pestisit kalıntı analiz ve çalışmaları, Erciyes Üniversitesi Fen Bilimleri Enstitüsü Dergisi, 32(1):72-82.

Toprak E., Gül A., 2013. Topraksız tarımda kullanılan ortam domates verimi ve kalitesini etkiliyor mu?, Tarım Bilimleri Araştırma Dergisi, 6 (2): 41-47.

TÜİK, 2016. Türkiye İstatistik Kurumu, www.tuik.gov.tr/ (accessed, March 25 2017).

Zengin E. and Karaca İ. 2017. Uşak İlinde Örtü Altı Üretimi Yapılan Domateslerdeki Pestisit Kalıntılarının Belirlenmesi, Süleyman Demirel University Journal of Natural and Applied Sciences, Published Online: 03.02.2017.

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