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Research Article

In Traditional Greenhouses A field Research in Terms of Occupational Health and Safety (Antalya Example)

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Abstract:

Although different levels of mechanization or automation systems are used in greenhouse cultivation depending on the infrastructure characteristics, there is an intensive use of human labor, especially for cultural operations. Therefore, the importance of occupational health and safety issues in greenhouse cultivation is increasing. Mechanization tools used, air conditioning systems, chemicals used, labour-intensive processes that require a certain muscle power and a certain posture during work, working at height, indoor air characteristics are among the main issues that need attention in terms of occupational health and safety. When the issues related to occupational health and safety in Turkey are examined, it is seen that studies have been carried out on different subjects such as working with agricultural machinery, chemical use, etc. However, it can be said that the studies on greenhouse cultivation are limited compared to other production branches. It is seen that the studies conducted consist of studies aimed at determining the situation in the form of field studies. Again, when the studies were examined, no study on indoor air in greenhouses, which is a closed environment, was found.

In this study, the indoor air in traditional greenhouses belonging to family businesses was examined in terms of occupational health and safety. In the research, data was collected from 135 farmers operating in traditional greenhouses during the year, and a survey was conducted in terms of occupational health and safety. The results of the study were statistically analysed with the SPSS 16 program. Analysis results were evaluated with an engineering approach within the scope of occupational health and safety.

1. Introduction

In developing countries, it is mostly operated by small farms or family businesses, and the wages of workers are quite low [1-5]. According to the International Labor Organization (ILO) 2021 data, about 1.1 billion people are engaged in agriculture. According to this report, a large number of temporary workers are employed by small and large growers. In addition, family members engage in unpaid agricultural labor to support informal agricultural labor or small-scale family farming [3]. According to European Union data, approximately 8.7 million people were working in agriculture in 2020 in European Union member states. It was stated that 9 out of every 10 workers (86.1%) were family businesses [1]. In Turkey, according to Turk Standard data, 16.8% of employees were working in agriculture in 2021 [4].

In the world and in Turkey, studies are carried out in different areas such as identifying risky issues in terms of occupational health and safety, statistics, raising awareness to prevent occupational accidents, training and legal sanctions. In this context, the studies carried out in this field in Turkey in recent years have started to be more on the agenda.

According to (TUIK, 2019) data, Turkey is a country with high agricultural potential in terms of production area, climate and geographical characteristics and the total agricultural area is 23,095,000 ha [6]. According to the Farmer Registration System (ÇKS, 2019), the total number of farmers is 2,132,491 [7].

According to (ACSHB, 2020), during the realization of agricultural production activities, workers may be exposed to different levels of hazards in terms of occupational health and safety. According to (ISGTS, 2013), activities with chemicals such as fertilizers and pesticides are classified as "very hazardous" [8]. Not paying attention to OHS issues has a cost burden in addition to human exposure [9]. The awareness that emerged in Turkey with the enactment of the Occupational Health and Safety Law has started to affect the agricultural sector. Although almost all activities carried out within the scope of both plant production and animal production are defined as hazardous, eliminating the risks and taking the necessary precautions are not realized at the desired level. For this reason, the importance of scientific and extension activities along with the legislation increases. For these studies, it is important to use site-specific databases. It is also necessary to take into account the differences in production branches and cultivation methods that are effective on OHS issues in the studies. For example, there are significant differences between dry field agriculture and animal husbandry in terms of OHS risk fact.

Sevgican et al. 2000, agricultural production is carried out in different production branches. Greenhouse cultivation has a special place in agricultural production. In addition to being a labour and capital intensive cultivation, the fact that production is carried out under a structure distinguishes greenhouse cultivation from other production branches. Greenhouses are movable structures that enable the economic cultivation of cultivated plants in periods when climatic conditions are not favourable for growing plants in the open, and can provide the development factors necessary for plant production [10].

According to (TUIK, 2021), greenhouse cultivation in Turkey is carried out in different ways. Modern greenhouse cultivation, traditional greenhouse cultivation, use of geothermal resources, highland greenhouse cultivation, fruit growing greenhouses, seedling greenhouses, etc. can be shown as examples of this diversity. With all this diversity, greenhouse cultivation in our country is concentrated in and around Antalya province. With this feature, Antalya province can be called the center of greenhouse cultivation. Greenhouse cultivation in Antalya started to increase especially with the farmers' greenhouses (traditional greenhouses) that started to be established towards the end of the 1960s. The total greenhouse area in Turkey reached 80515.9 ha as of 2020. Of the total area, 27% is low tunnel, 13% is high tunnel, 50% is plastic greenhouses and 10% is glass greenhouses [11].

Of the total 48257.5 ha of plastic greenhouse areas, 83% are plastic greenhouse areas and 17% are glass greenhouse areas. Greenhouse cultivation has developed especially in the Mediterranean coastal zone where climatic conditions are favourable. Approximately 55% of plastic greenhouses and 85% of glass greenhouses are located in Antalya province. Approximately 60% of the total greenhouse areas are located in Antalya province. In addition, in greenhouse cultivation, vegetable cultivation in traditional greenhouses in family businesses is the most common form of production.

(AÇSHB, 2020), Greenhouse cultivation is a branch of production that has a special place in agricultural production. Although it is labour intensive, the fact that production is carried out under a structure and requires working with different machinery and systems diversifies the OHS risk factors in greenhouse cultivation. In this respect, the main issues to be considered in terms of OHS in greenhouses can be listed as safety behaviour, training and information, layout and cleaning, machinery and systems, transportation and internal transportation, occupational hygiene / thermal comfort, ergonomics, working at height, chemicals, wastes, emergencies, electricity [9].

1.1. Survey of Studies on Indoor Air Quality in Traditional Greenhouses

Aslan and Aybek (2016), in their article, emphasized that workers in agriculture are exposed to various dust and gases arising from the work done, and that the solid particles exposed to particulate matter (PM) are effective in the upper and lower respiratory tract of people, causing various respiratory disorders and diseases. In order to protect human health and welfare in the world, governments and health organizations have set permissible limit values, threshold limit values, etc. for inhaled PM concentrations. These values vary depending on the organization that sets the limit. In this study, occupational respiratory diseases and illnesses encountered by people exposed to PM concentrations in different size fractions in agriculture and agro-industry, limit values recommended in different countries, research topics and perspectives, policies and measures implemented were examined and discussed [12].

Özmerzi and Kürklü (1989) examined natural and forced ventilation methods in plastic and glass greenhouses. It was reported that the methods have advantages and disadvantages compared to each other[13].

In their study, Kürklü and Başçetinçelik (1990) explained the heating systems used in greenhouses and compared these systems with the systems used

in greenhouses in Antalya region. It was explained that solar energy is not utilized in the region although it is quite favorable[14].

Sallanbaş (1992) investigated climate control in greenhouses in Antalya region. In the study, environmental factors, ventilation, heating, cooling and humidity control issues were examined[15].

Çanakcı and Akıncı (2004) determined the agricultural structure and mechanization characteristics of traditional greenhouse vegetable farms in Antalya province[16].

Turhanoğulları (2013), in his doctoral study, investigated the qualifications, behaviors, working conditions, risks they may encounter in terms of health and safety, their level of knowledge about risks and methods of protection from risks in greenhouse enterprises in Antalya province[17].

Özdemir A.B., (2016) "Examination of the risks related to plant protection chemicals used in vegetable greenhouses", there is also a master's thesis on the effects of chemicals in traditional and business greenhouses in Antalya province[18].

Akyıldız,S., Çakmak, B, Alayunt,N. F., Karakitapoğlu, N.A., (2017) , an article titled "The effect of media on the development of occupational health and safety culture in the agricultural sector"[19].

Aday and Ertekin (2018) conducted a research titled "Creation of Solar Energy Supported Magnetic Field Tracking Greenhouse Carrier Vehicle Prototype"[20].

1.2. Health Effects of Polluted Indoor Air in Greenhouses

Raising the standard of the working environment in workplaces is not only necessary to protect the health of workers, but also to improve the quality of work and the productivity of the workplace. The following three issues are very important in workplaces:

Health –

being fit and in good condition at home and at work,

Environment –

the working environment is organized, comfortable and free of dust, smoke and gases,

Safety –

reducing the risk of accidents.

While technology offers us comfortable, modern products, some pollution occurs during the production of these products.

These are respectively;

- Dust,
- Fumes,
- Oil and other vapors,
- Gases.

Fumes and dusts generated in the industry include the following hazards: - Solvents, - Welding fumes, - Particles, - Gases, - Solder fumes, - Chemicals - liquids.

(Gökşin, H, A. and Stand, A (2001), in their studies, pests caused by pollutants affecting indoor air quality cause damage to many organs in the human body such as brain, lungs, skin, blood, kidneys, limb nerves, liver. In addition, these pests try to enter our body when we breathe and our body is vulnerable to them [21].

When it comes to the working environment in greenhouses, it is the inside of traditional greenhouses. Therefore, we have to accept the inside of the greenhouse as the working environment. With this approach, temperature, relative humidity, CO2, particulate matter amounts are of great importance for employees (farmers) in the indoor air quality evaluation by American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE), which sets indoor air quality standards within the scope of occupational health and safety. In addition to ASHRAE standards, other country standards are presented in table 1.

Table 1: *ASHRAE standards for indoor air quality by country in the world[23,24]*

Ülkeler	CO_2	Partikül madde	Bağıl nem	Sıcaklık
ABD ASHRAE	1000 ppm	$PM_{10} < 75\ \mu g/m^3$ (yıllık ortalama)	%30-60	20-25,5 °C
ABD EPA/NAAQS		50 g/m^3 (1 yıl için)		
ABD NIOSH	5000 ppm 30 000 ppm (15 dakika)			
ABD OSHA	10 000 ppm 30 000 ppm (15 dakika)	5 mg/m^3 (8 saat) solunabilir toz		
ABD ACGIH	5000 ppm 9000 ppm (15 dakika)	3 mg/m^3 (8 saat için)		
Almanya MAK	5000 ppm 9000 ppm (15 dakika)		%30-70	20-26 °C
Kanada	3500 ppm	$PM_{2,5} < 40\ \mu g/m^3$ (8 saat) $PM_{2,5} < 100\ \mu g/m^3$ (1 saat)	%30-80 (yaz) %30-55 (kış)	
Çin		$PM_{10} < 150\ \mu g/m^3$		
WHO		$PM_{10} < 20\ \mu g/m^3$ (yıllık ortalama) $PM_{10} < 50\ \mu g/m^3$ (24 saat)		
İngiltere		$PM_{10} < 50\ \mu g/m^3$		
Norweç		$PM_{2,5} < 20\ \mu g/m^3$		
Avrupa Birliği		$PM_{2,5} < 35\ \mu g/m^3$		
Hong Kong	800 ppm (1. düzey) 1000 ppm (2. düzey)	$PM_{10} < 20\ \mu g/m^3$ (1. düzey) $PM_{10} < 180\ \mu g/m^3$ (2. düzey) (8 saat ortalama)	%40-70	20-25,5 °C

2. Material and Methods

In this study, Konyaaltı, Döşemealtı, Kepez, Aksu and Muratpaşa, which are the five districts of Antalya province in Turkey, were selected as the study area for the survey. In determining the number of enterprises to be surveyed, the total number of greenhouse enterprises operating in Aksu, Muratpaşa, Kepez, Döşemealtı and Konyaaltı districts was taken into consideration as the main mass. According to the records of Antalya Chamber of Agriculture, the total number of enterprises in these districts is 8217. The sampling to determine the number of enterprises to be surveyed was based on 1% of the total number. This number is considered

to be sufficient for sampling large populations (Işık, 1996). In order to increase the reliability in the study, the number of the sample[22] was increased by 60% and a face-to-face survey was conducted with a total of 135 enterprises.

Figure 1 shows a visual map of the research area in 5 districts of Antalya province in Turkey and Figure 2 shows a visual map of the neighbourhoods where the survey was conducted in the five districts.

Figure 1: *Research Region map view of the five districts in the center of Antalya Province*

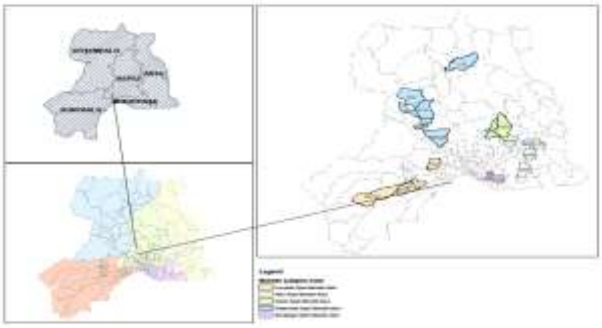


Figure 2: *Map view of the neighbourhood's studied in the districts within the Research Region*

Table 2 shows the number of respondents in 7 neighbourhoods in each of the 5 districts. The questionnaire application in this study was conducted using the face-to-face method. Both the data obtained from the questionnaires and observation notes were used in the evaluations. These data were organized and interpreted by performing simple arithmetic and proportional operations as well as statistical analysis.

Table 2. *Number of respondents in 7 neighbourhood's in each of the five districts*

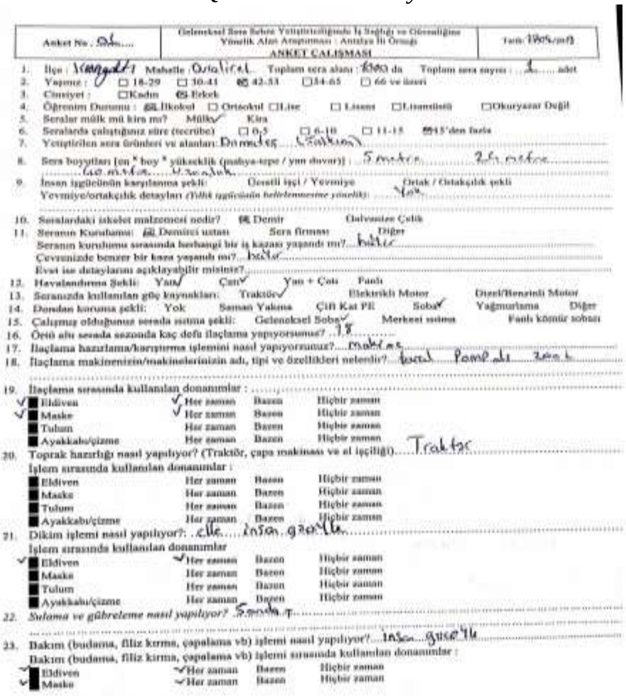
District/ Neighborhood	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Number of Surveys**	**rate(%)**
Konyaaltı	Çakırlar	Duraliler	Hacı sekililer	Su çiçeği				24	%18
Aksu	Altıntaş	Barboros	Çamköy	Çamur	Hacıaliler	Macun		44	%33
Kepez	Altıayak	Gaziler						30	%22
Döşemealtı	Bahçekaya	Çığlık	Ekşili	Kırkgöz	Temalar	Yeniköy	Yeşilbayır	20	%15
Muratpaşa	Güzeloluk	Kırcami	Tarım					17	%12
							Total	**135**	**%100**

In the questionnaire, 38 questions related to occupational health and safety were asked to the participants. In this context, data analysis was performed in SPSS 16.0 program. Possible statistical relationships between variables in the study were Pearson chi-square and the results were interpreted in accordance with the purpose.

The sample questionnaire used in this study is given in Table 3. Greenhouse areas (da) by districts are given in Figure 3. From the distribution of 332.41 decares of greenhouses in the study area in five districts, it was determined that the highest greenhouse area was in 27% slice. Aksu district with an area of 89.12 decares in the figure 3 shows that 33% of the 317 greenhouses in the survey study area are in Aksu district, which has 104 greenhouses.

The distribution of age groups in the study area in the districts is shown in Table 4. When the distribution of age groups in the working area is analyzed; it is determined that the highest number is in the 42-53 age group. In terms of OHS

Table 3: *Questionnaire Study Form*



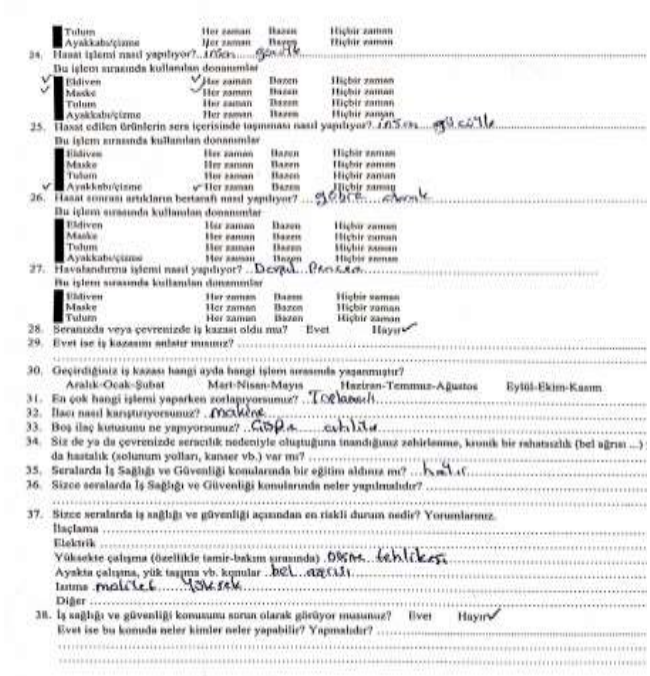
Anket No : ... | Geleneksel Sera Sebze Yetiştiriciliğinde İş Sağlığı ve Güvenliğine Yönelik Alan Araştırması : Antalya İli Örneği — ANKET ÇALIŞMASI | Tarih: ...

1. İlçe : ... Mahalle : ... Toplam sera alanı : ... da Toplam sera sayısı : ... adet
2. Yaşınız : ☐ 18-29 ☐ 30-41 ☐ 42-53 ☐ 54-65 ☐ 66 ve üzeri
3. Cinsiyet : ☐ Kadın ☐ Erkek
4. Öğrenim Durumu : ☐ İlkokul ☐ Ortaokul ☐ Lise ☐ Lisans ☐ Lisansüstü ☐ Okuryazar Değil
5. Seralar mülk mü kira mı? Mülk Kira
6. Seralarda çalıştığınız süre (tecrübe) ☐ 0-5 ☐ 6-10 ☐ 11-15 ☐ 15'den fazla
7. Yetiştirilen sera ürünleri ve alanları: ...
8. Sera boyutları [en * boy * yükseklik (mahya-tepe / yan duvar)] : ...
9. İnsan işgücünün karşılanma şekli: Devamlı işçi / Yevmiye Ortak / Ortakçılık şekli
Yevmiye/ortakçılık detayları (Tüm işgücünün belirlenmesine yönelik): ...
10. Seralardaki iskelet malzemesi nedir? Demir Galvanize Çelik
11. Seranın Kurulumu: Demirci ustası Sera firması Diğer
Seranın kurulumu sırasında herhangi bir iş kazası yaşandı mı? ...
Çevrenizde benzer bir kaza yaşandı mı? ...
Evet ise detaylarını açıklayabilir misiniz? ...
12. Havalandırma Şekli: Yan Çatı Yan + Çatı Fanlı
13. Seranızda kullanılan güç kaynakları: Traktör Elektrikli Motor Dizel/Benzinli Motor
14. Dondan koruma şekli: Yok Saman Yakma Çift Kat PE Soba Yağmurlama Diğer
15. Çalışmış olduğunuz serada ısıtma şekli: Geleneksel Soba Merkezi ısıtma Fanlı kömür sobası
16. Örtü altı serada sezonda kaç defa ilaçlama yapıyorsunuz? ...
17. İlaçlama hazırlama/karıştırma işlemini nasıl yapıyorsunuz? ...
18. İlaçlama makinenizin/makinelerinizin adı, tipi ve özellikleri nelerdir? ...
19. İlaçlama sırasında kullanılan donanımlar : ...
- Eldiven — Her zaman / Bazen / Hiçbir zaman
- Maske — Her zaman / Bazen / Hiçbir zaman
- Tulum — Her zaman / Bazen / Hiçbir zaman
- Ayakkabı/çizme — Her zaman / Bazen / Hiçbir zaman

20. Toprak hazırlığı nasıl yapılıyor? (Traktör, çapa makinası ve el işçiliği) ...
İşlem sırasında kullanılan donanımlar :
- Eldiven — Her zaman / Bazen / Hiçbir zaman
- Maske — Her zaman / Bazen / Hiçbir zaman
- Tulum — Her zaman / Bazen / Hiçbir zaman
- Ayakkabı/çizme — Her zaman / Bazen / Hiçbir zaman

21. Dikim işlemi nasıl yapılıyor?: ...
İşlem sırasında kullanılan donanımlar
- Eldiven — Her zaman / Bazen / Hiçbir zaman
- Maske — Her zaman / Bazen / Hiçbir zaman
- Tulum — Her zaman / Bazen / Hiçbir zaman
- Ayakkabı/çizme — Her zaman / Bazen / Hiçbir zaman

22. *Sulama ve gübreleme nasıl yapılıyor?* ...
23. Bakım (budama, filiz kırma, çapalama vb) işlemi nasıl yapılıyor? ...
Bakım (budama, filiz kırma, çapalama vb) işlemi sırasında kullanılan donanımlar :
- Eldiven — Her zaman / Bazen / Hiçbir zaman
- Maske — Her zaman / Bazen / Hiçbir zaman



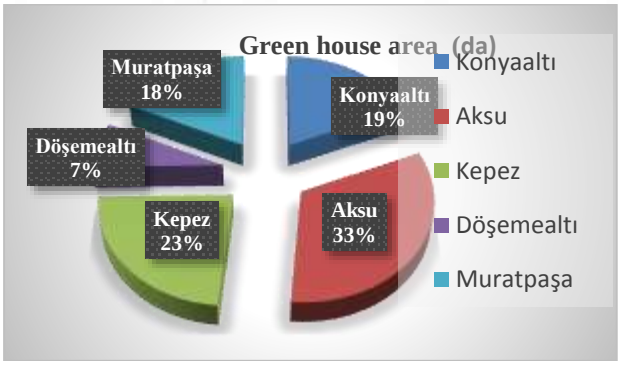


Figure 3: *Greenhouse areas by district (da)*

Table 4: *Distribution of age groups in the study area*

District/ Age Groups	18-29 years	30-41 years	42-53 years	54-65 years	More than 65 years	General total
Konyaaltı	2	2	14	6		24
Aksu	5	7	17	14	1	44
Kepez	1	10	14	5		30
Döşemealtı	5	7	6	2		20
Muratpaşa	2	6	3	5	1	17
Total (Number)	15	32	54	32	2	135
Percentage rate (%)	11.1	23.7	40.0	23.7	1.5	100

(Occupational Health and Safety), it has been observed that the 42-53 age group is in the middle age group and the most productive ones are sufficiently experienced.The distribution of gender by study area in the districts is given in Table 5. When the distribution of gender by work area is analyzed; it is determined that the majority of the employees working in the sector are men.

Table 5: *Distribution of gender by study region*

District/ Gender	Woman	Male	General Total (Number)
Konyaltı	8	16	24
Aksu	12	32	44
Kepez	3	27	30
Döşemealtı	4	16	20
Muratpaşa	4	13	17
General Total, (quantity)	31	104	135
Percentage rate (%)	**23**	**77**	100

Table 6 shows the distribution according to their educational backgrounds in the questionnaire study.

Table 6: *Distribution of educational attainment by region of study*

Graduaduation	Quantity	Percentage Rate (%)
Primary school	70	51,9
Middle school	32	23,7
High school	23	17,0
Bachelor's degree	6	4,4
Postgraduate	1	0,7
illiterate	3	2,2
Toplam	135	100

It has been determined that more than half (51.9%+2.2%) of the employees in this production branch are primary school graduates and illiterate. It has been determined that OHS trainings should be organized considering the illiterate education level
In this study, the results of the examination of the experience status of 0-5 years of experience and 6-10 years of experience are given in Table 7.

Table 7*: Experience level of the respondents*

District/ Experience	0-5 years	6-10 years	11-15 years	More than 15 years	Total Number of People (Person)
Konyaaltı	1	2	11	10	24
Aksu	1	6	7	30	44
Kepez		8	4	18	30
Döşemealtı	5	6	4	5	20
Muratpaşa	2	4	3	7	17
Grand total	9	26	29	70	135
Percentage rate (%)	6,7	17,0	21,5	51,9	100

In this study, it was determined that 51.9% of the respondents had more than 15 years of experience and 6.7% had the least experience (0-5 years).
In this study, the results of the investigation on the ventilation conditions of the greenhouses are given in Table 8. It has been determined that 120.21 decares of greenhouse area of the Study Area is ventilated by side ventilation; 7.00 decares of greenhouse area is ventilated by roof ventilation; 202.70 decares of greenhouse area is ventilated by Side + Roof; 2.50 decares of greenhouse area is ventilated by fan. The fact that the volume and air in greenhouses are limited, and that greenhouses are built with the least cost not as a working place but as

Table 8: *Ventilation Type of Greenhouses*

District/Greenhouse Ventilation Type	Side (da)	Roof (da)	Side + Roof (da)	Forced Ventilation fan (da)	Total (da)
Konyaaltı	4,05		41,55	2,50	48,10
Aksu	36,59		52,53		89,12
Kepez	43,57		24,38		67,94
Döşemealtı	12,00	7,00	34,25		53,25
Muratpaşa	24,00		50,00		74,00
General total	120,21	7,00	202,70	2,50	332,41
Percentage rate (%)	**36.2**	**2.1**	**61.0**	**0.8**	100.00

a growing environment for plants carries great risks in terms of OHS. Considering that greenhouses are also a working environment, during the design and establishment of modern greenhouses with new architectural designs; the use of Air Conditioning Systems that control the temperature, humidity, air movement, distribution and cleaning of air in greenhouses should be encouraged with support.
The participants of the survey were asked about the number of times spraying is done in greenhouses according to the product type and the results shown in figure 4 were obtained.

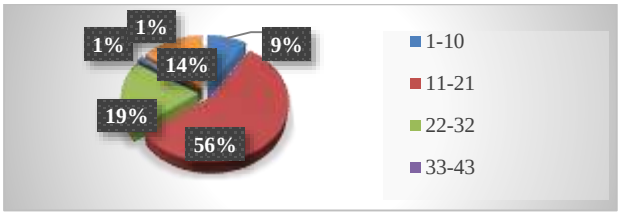


Figure 4: *Percentages of the number of times of spraying in greenhouses*

According to figure 4, 56% of the respondents stated that they sprayed 11-21 times a season, while 19% of the respondents reported that they sprayed 22-32 times a season.
In this case, considering that an employee sprayed 1 da area in 1 hour, in this survey study, in a total of 332.46 decares of greenhouse area, 332.46 da x1h*15 defa= 4,986.9 h average spraying time, employees are exposed to pesticides.

When the total duration of exposure to pesticides is taken into consideration, the importance of OHS related PPE is understood more. These personal protective equipment are Mask, Gloves, Overalls, Overalls, Shoes / Boots. These personal protective equipment must be worn. The respondents were asked about the preparation of the pesticide and the method of mixing the pesticide during spraying in the greenhouse. The method of digging/mixing the pesticide is given in figure 5. According to figure 5, 20% of the respondents reported that they prepare and mix medicines by hand, while 39% reported that they use sticks and 39% that they use machines for "preparation and mixing".
Considering that 20% of the employees mix chemical drugs by hand, employees exposed to chemicals may have health problems such as skin and lung cancer. Table 9 shows the type, brand and model of the pharmaceutical machine and the type of motor/pump used in the survey.

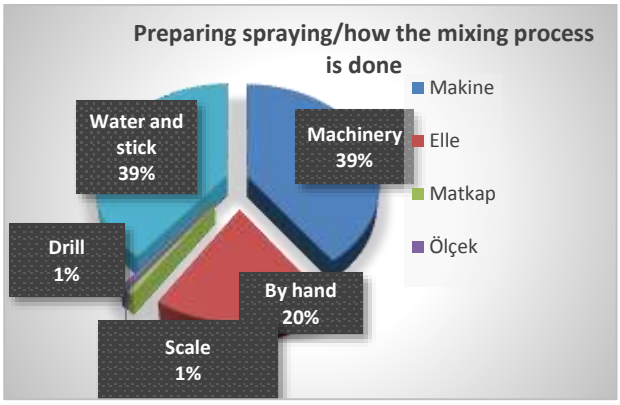


Figure 5: *Views of the method of preparation and mixing of pesticides in greenhouses*

Table 9: *Types, brands and models of pharmaceutical machines and types of motors/pumps used in the survey*

Pharmaceutical machinery model, brand	Type/name of spraying engine	Example Spraying machines
1 Ton Tank Aksa brand pharmaceutical machine Başaran branded 500 lt (type attached to the back of the tractor) Basari brand pharmaceutical machine Baskal brand pharmaceutical machine Belda hanging type medicine machine Unknown It doesn't belong to us Hand Hoe hand pump electric pump electric pump electric motor electric motor Electric 100 lt electric medicine tank Emre agricultural machinery Horsan brand Taral gasoline engine Taral Cobra Taral brand gasoline	medicine machine drug engine medicine pump medicine pump medicine pump medicine pump diesel Kaan Kaan 400lt (model unknown) Castle Koroglu 200L Doesn't know brand Oleo-mac 30 lt (carried on the back) Pump Palace to hug supermot Taral gasoline engine Taral Cobra Taral brand gasolin	  

According to Table 9; the subjects working in the research area were asked to explain the equipment used during spraying; 20% of the subjects reported that they used a rented sprayer, while 80% reported that they used their own sprayer.
In terms of OHS, it was observed that they did not have sufficient knowledge about the maintenance and use of the equipment (nozzle, spraying apparatus, pump) of sprayers.
In the questionnaire study, the % values given for the use of gloves, masks, overalls, shoes/boots during spraying are given in figure 6.

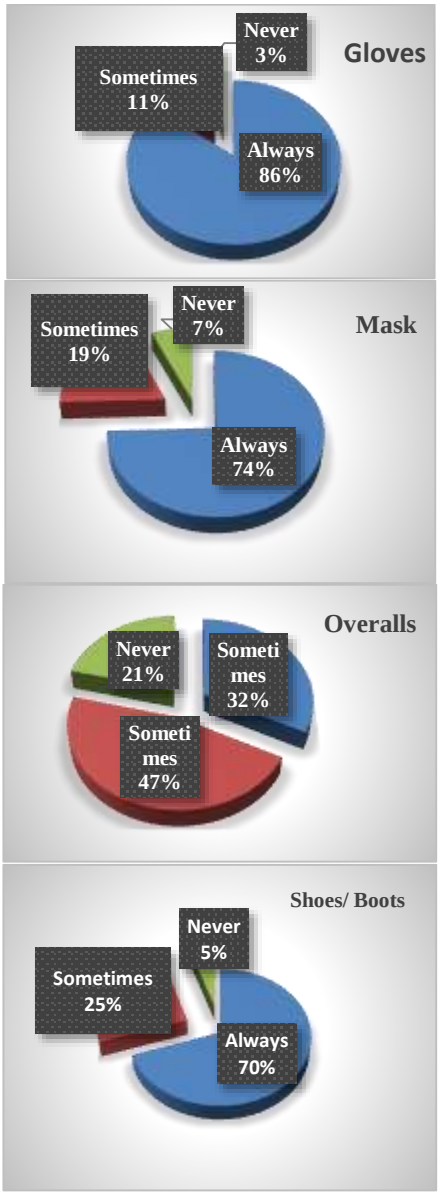


Figure 6: *Percentages (%) of wearing gloves (a), mask (b), overalls (c) and shoes/boots (d) among PPE equipment*

According to figure 6, the proportion of those who always use the equipment used during spraying is 86% for gloves, 74% for mask, 32% for overalls, and 70% for boots.

It was determined that overalls, which are PPE in terms of OHS, are not wanted to be used during spraying at a very high rate. It is thought to be the biggest source of health problems.
The answers given to the questionnaire about what is done with empty medicine boxes after spraying are given in figure 7 in terms of percentages.

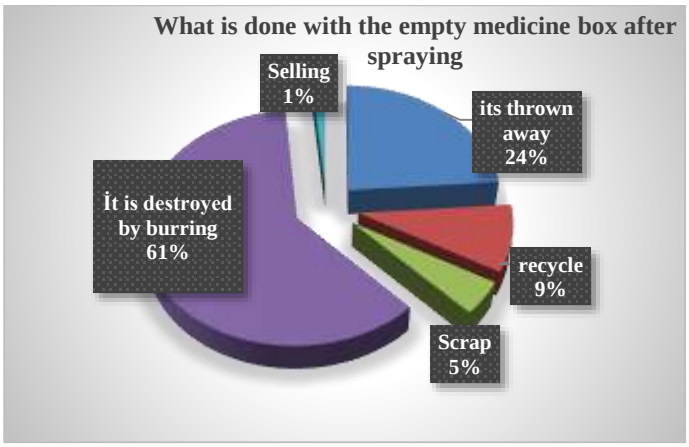


Figure 7: *Percentages (%) of what is done with empty medicine boxes*

According to figure 7, 61% of the employees in the Study Area stated that "they are disposed of (by burning)" and 24% stated that "they are thrown in the garbage".
It has been determined that no precautions are taken in terms of environmental pollution and OHS as chemicals are mixed with the air during incineration. In terms of OHS, it is revealed that the exposure of the chemicals in the air during incineration to the people doing the incineration carries a risk in terms of health.

What should be done about OHS issues" was asked to the respondents and the percentages of the answers are given in figure 8.

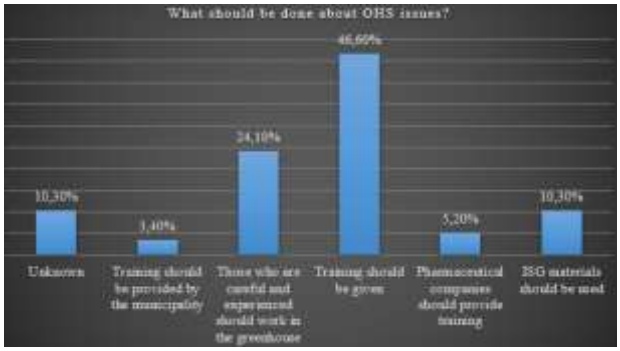


Figure 8: *What should be done about OHS issues?*

According to figure 8, the employees in the Study Area were asked; Do you or anyone around you have any poisoning, chronic illness (back pain ...) or disease (respiratory tract, cancer, etc.) that you

believe to be caused by greenhouse cultivation? All of the respondents stated "no".
Have you received any training on Occupational Health and Safety in greenhouses? All of the subjects answered "No" to the question.
In addition, when the answers given by the subjects to the question of what should be done about Occupational Health and Safety in greenhouses are grouped; 46.6% of them said "Training should be given", 24.1% of them stated that "Those who are careful and experienced should work in the greenhouse". It has been determined that the producers are in expectation that OHS training should be provided not only by public institutions but also by private sector, municipalities, etc. organizations that are effective in the region. The most risky situation such as working standing, carrying loads, etc. was asked to the respondents in figure 9 in the questionnaire.

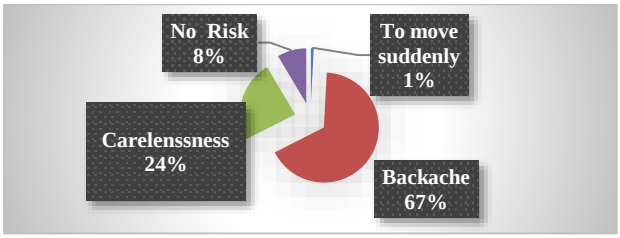


Figure 9: *OHS My most risky situations such as standing, carrying loads, etc. (%)*

According to figure 9, when the employees in the Study Area were asked "In your opinion, what is the most risky situation in spraying in terms of OHS in greenhouses?", all of the respondents stated "Poisoning". When asked to interpret in terms of electricity, all of the respondents stated "Electric Shock". As for the risk of working at height, all employees stated that "falling" would be the most risky result. In terms of heating, cost was declared to be the most risky situation. Regarding standing work, carrying loads, etc., 67% of the employees declared "Back Pain" and 24% declared "Carelessness" as the risky situation.
In terms of OHS, it is necessary to take precautions for work accidents such as chemicals, electric shock, falling from height, ergonomic mechanization should be done in order to prevent health problems such as herniated discs, sitting work platforms in greenhouses in terms of ergonomics.

3. Results and Discussions

According to the test results made with SPSS 16, which is a statistical analysis program, the survey results were conducted in the field survey for OHS of traditional greenhouse vegetable growing areas in the central district of Antalya province;

a) Considering the disposal methods of medicine containers created by chemicals used in greenhouses; It was determined that there was a significant relationship between education and the disposal of medicine boxes, that there was a significant relationship between gender and the disposal of medicine boxes, and that there was a significant relationship between age groups and the disposal of medicine boxes.
It has been determined that there is a significant relationship between districts and the use of gloves and masks, which are personal protective equipment (PPE), during spraying in greenhouses.
It has been determined that there is a significant relationship between age and PPE gloves during spraying in greenhouses.

b) It was determined with the SPSS 16 statistical program that there is a significant relationship between the use of gloves, masks and overalls during ventilation in greenhouses.
c) In the 38-question survey conducted with a total of 135 people in traditional greenhouses, it was seen that the other questions did not have a significant relationship with each other. However, it was determined in this study that OHS-related problems in traditional greenhouses could be revealed on a district basis by increasing the number of surveys.

4. Conclusions

It is of great importance to pay attention to prevention-protection activities, which are the basic principles of occupational health and safety, during the carrying out of agricultural activities. For this purpose, the use of personal protective equipment (PPE) becomes mandatory in cases where the mentioned practices are insufficient, which comes after the methods such as disposal, substitution, taking engineering measures, applying organizational methods, etc., which we recommend as the last stage in the applications. It is stated that agricultural workers are exposed to more dust, especially in open field work, when there is extreme wind and low ambient humidity, and when the product moisture is low, in which case the use of PPE is recommended [23].
When OHS issues regarding greenhouse cultivation, which can be defined as a special field of study, are examined, it is seen that it includes many risk factors and has many aspects that are open to work accidents and occupational diseases.
It is thought that it is necessary to carry out comprehensive and systematic studies with the participation of relevant organizations on greenhouse cultivation in Antalya province, which is the center of greenhouse cultivation in Turkey.

In this study, especially considering that the greenhouse is a closed environment, studies can be carried out on dust particulate matter (PM), especially the suspended dust particle distributions in the greenhouses, by making maps with Geographic Information System (GIS) applications, and multi-disciplinary master's and doctoral subjects. We are of the opinion that it is an open area. Monitoring chemical exposure levels over time and impact analysis of exposure reduction strategies, Evaluation of the ergonomic suitability of machines and equipment used in greenhouses,We believe that pilot applications of new ventilation and pesticide techniques are important for future studies.

Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
- **Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper
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- **Data availability statement:** The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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