RESEARCH ARTICLE

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Determination of awareness levels of walnut producers in plant protection applications (a case study of Bitlis province)

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Abstract

The survey was conducted in 2020 to determine the awareness level of walnut producers regarding crop protection practices in Adilcevaz and Hizan districts of Bitlis province, where walnut production is widespread. With this in mind, a face-to-face survey was conducted using a simple random sampling method among 87 producers in a total of 10 randomly selected villages from two districts. Within the scope of the research, walnut growers were found to be highly educated and most had non-agricultural income. The manufacturers in question take into account the recommendations of sellers and Agriculture and Forestry department when choosing pesticides and deciding on the usage dose rates, that the brand recognition and active ingredients are important to pesticide preferences, that they don't use the same pesticides in the fight against the same diseases and pests, They start spraying without seeing the signs of disease and harmful factors in the plant, they apply the recommended dose in drug applications, pesticides used leave residue on product. They observe the waiting time between spraying and harvesting and wear protective clothing and masks during spraying, they do not simply throw-away empty pesticide box and packages used after the application into the agricultural fields or their surroundings, they clean the sprayer, but they use the sprayer without calibration, they mix pesticides and prefer cultural methods over chemical methods, and they do not have any knowledge about the word biopesticide. It is known that producers generally choose chemical control in the solution of plant protection issues, and the indiscriminate use of these pesticides has many adverse effects on human and environmental health.

Keywords: Plant Preservation Issues, Questionnaire, Walnut, Bitlis

INTRODUCTION

Due to the vitamins it contains, walnut (*Juglans regia* L.) is a highly beneficial fruit for human nutrition and maintenance of health. Walnut has a wide range of use. As well as being consumed as snack, its leaves are used for various purposes and its trees and green bark are used for furniture manufacturing. This makes the fruit even more significant globally. Walnuts are widely grown in Turkey and constitute one of the most important livelihoods of people living in Anatolia (Keskin, 2012).

Among the hard-shelled fruits, walnut ranks first in the world with a share of 9.3% and in the first place with a production amount of 25.8% (Anonymous, 2020). According to 2019 data, People's Republic of China ranks first in global walnut

production with an annual production of 1.586.367 ton. United States of America ranks second with 613.260 ton, Iran ranks third with 409.562 ton and Turkey ranks fourth with 286.000 ton walnut production (Anonymous, 2020).

In 2020, 286 thousand tons of walnut production was realized in Turkey. The highest production was realized in Hakkari with approximately 12 thousand tons. Hakkari was followed by Kahramanmaraş with 11.4 thousand tons and Mersin with 11 thousand tons. In Bitlis, 4919 tons of walnuts were produced (Anonymous, 2021)

Walnuts have an important place in both domestic consumption and exports. In walnut orchards, there are many diseases, pests and weed species that harm alone or together. The most important of these are apple worm *Cydia pomonella* (L.) (Lepidoptera: Tortricidae) *Callaphis juglandis* (Goeze) and *Panaphis juglandis* (Goeze) (Hemiptera: Aphididae) aphids as the main pest of walnut, Tree yellowweed *Zeuzera pyrina* (L.) (Lepidoptera: Cossidae), American white butterfly *Hyphantria cunea* (Drury) (Lepidoptera: Erebidae), apple leafhopper *Archips rosanus* (L.), common leaf bender *A. xylosteanus* (L.), Lepidoptera: Tortricidae), Pear lace bug *Stephanitis pyri* (Fabr.) (Hemiptera: Tingidae), *Lepidosaphes ulmi* (L.) (Hemiptera: Diaspididae), *Aceria erinea* (Nalepa) and Acarina: Eriophyidae, among the main diseases, there are *Gnomonia leptostyla* (Fr.: Fr) Ces & De Not., *Microstroma juglandis* (Berenger) Sacc., *Phytophthora* spp., Cystospore cancer *Leucostoma cincta* (Fr.: Fr.) Höln.. Tul. *Xanthomonas arboricola* pv. juglandis (Pierce) Vauterin et al. These are some of the common pests and diseases causing economic damage in walnut (Anonymous. 2017). Depending on periods and climate conditions, these factors can cause yield and quality losses. As such, it has been reported that at certain times, climate conditions lead to increased pest and disease population in agricultural production areas. The indiscriminate use of these pesticides has many adverse effects on human and environmental health.

The need for food increases in direct proportion to the increasing world population (Avan and Kotan, 2021). In Turkey, which has a very rich flora, it is very important to grow these plant materials in a healthy and high quality and to protect these products (Avan, 2021). It is also very important to transfer the plant protection methods to the producer correctly.

This study was conducted to identify crop protection issues in walnut fields in Bitlis due to the fact that plant protection has an important place in agricultural production and the intensive use of pesticides in walnut fields. As a result of the study, it has been determined what the producers do when they encounter plant protection problems, whom they consult, what they pay attention to in the selection and use of agricultural pesticides and spraying machines, and what they think about the effects of agricultural pesticides on the environment. Based on the results obtained, the problems in the use of plant protection products in walnut areas were determined and attention was drawn to solution-oriented processes and solutions.

MATERIALS AND METHODS

The main material of the study was a questionnaire consisting of 20 questions made face-to-face with enterprises producing conventional walnuts in Adilcevaz and Hizan districts of Bitlis province. Obtained answers were given in terms of number and ratio. In Adilcevaz and Hizan district, which was determined as the research area of the study, 874 walnut production businesses registered with the Farmer Registration System (FRS) in 2019, and the enterprises were calculated in the 95% confidence interval (Anonymous, 2020). The above producers make up 9.52% of the 21,548 producers activity in Bitlis. It was impossible to conduct a survey with all the enterprises operating in Adilcevaz and Hizan districts, therefore, The number of producers surveyed was determined using a simple random sampling method with the following formula (Çiçek and Erkan, 1996).

n= N (pq)/ (N-1) D2+ (pq)

$$n=N\times S2\times t2 /(N-1)d2 + (S2 \times t2) \quad (1)$$

In the equation;

n: number of samples

S: population variance

N: Number of producers that make up the population

t: standard normal distribution value

d: population error term

The study was carried out error within 5%, confidence limit within 95% in determining the sample size of the study. Then, using the formula, calculated number of producers to interview as 87. The data obtained from walnut producers were evaluated by giving tables.

RESULT AND DISCUSSION

Socio-Economic Traits of Walnut Producers

The demographic structure of the participant enterprises in Bitlis (Adilcevaz and Hizan district) has been studied. The study indicated that all walnut producers in the districts are male, 4% are illiterate, 7% are literate, 39% are primary school graduate, 11% are secondary school graduate, 18% are high school graduate and 21% are University/College graduate (Table 1). In other similar studies, 60% of stone fruit producers in Korkuteli district of Antalya province graduated from primary school and 12% graduated from college; 62.41% - 87.50% of the farmers producing carrots in Konya were primary school graduates; 63.3% of Antalya's apple growers have a primary school degree and 14.4% of them have a university degree. 64.6% of potato growers in Nevsehir have completed primary school and 1.1% have a university degree. Almond farmers in Adiyaman are 91.4% male and 8.6% female, of which 14 have a primary school degree, 24.7%

have a secondary school degree, 40.9% have a university degree, and 20.4% have a university degree. increase; all of the vineyard producers in Mardin were male, 20% were illiterate, 64% were primary school graduates, 12% were secondary school graduates, and 4.4% university graduates. (Ay et al., 2006; Çelik and Direk, 2008; Kızılay and Akçaöz, 2009; Erdoğan and Gökdoğan, 2017; Erdoğan et al., 2017; Kaplan and Baran, 2021).

It has been observed that 77% of the walnut producers in Bitlis state has social insurance and 65.6% have non-agricultural income. (Table 1). It was also observed that 53.6% of farmers in Seyhan and Yüreğir districts of Adana state have social safety and 70.5% have no non-farm income.; In Manisa, 64% of farmers have social safety and 66% have no income other than farming; In Nevsehir province, 73.5% of farmers have social safety, 26.5% do not, of which 31.2% have non-farm income and 68.8% have non-farm income; 83.9% of almond farmers in Adıyaman have social safety and 65.6% have non-farm income; 73.9% of the viticulturists in Mardin have social safety and 55.6% have non-farm income (Emeli, 2006; Karataş and Alaoğlu, 2011; Erdoğan and Gökdoğan, 2017; Kaplan and Baran, 2021).

Table 1. Demographic details of the participating walnut producers in Bitlis province

(%) Traits	Rate (%)
Gender	
Male	100
Female	0
Education Status	
Illiterate	4
Literate	7
Primary School	39
Secondary School	11
High School	18
College/University	21
Employment Status	
Farmer	86
Tradesman	6
Worker	4
Civil Servant	2
Retired	3
Social Security	
Yes	77
No	23
Non-Agricultural Income	
Yes	65.6
No	34.4

Knowledge, attitudes and behaviors of producers on plant protection products

When choosing pesticides, 61.75% of walnut producers in Bitlis (Adilcevaz and Hizan) get information from the Provincial and District Directorate of Agriculture and Forestry, 28.50% get information from vendors, and 11.75% rely on their own experience. and their neighbour (Table 2). In line with the current results, Tücer et al. (2004) reorted that 65% of Manisa winegrowers based their choice of pesticides on their provincial/district agricultural directorates, 16% based on their own experience, 11% based on their suppliers, 8 % reports that it's based on neighbors. Kalkışım et al.(2011), 43.08% of fruit producers in Gümüşhane choose their pesticides based on technical staff recommendations and 3.08% on recommendations by vendors. Erdoğan and Gökdoğan (2017) 88.9% of the producers in Nevşehir base their pesticide selections on vendors, 7.9% on their own experiences, 2.1% on agriculture agencies, 0.5% on their neighbour and 0.5% on consultant Agricultural Engineer. (Erdoğan et al. (2017) stated that 44.1% of the almond growersers in Adıyaman base their pesticide selection on Provincial Directorate of Agriculture, 32.3% on vendors, 19.4% on consultant Agricultural Engineer, 3.2% on their neighbour and 1.1% on their own experience. Kaplan and Baran (2021) reported that 34% of Mardin winegrowers base their pesticide selection on state/district agriculture and forestry offices, 52.50% on vendors and 2% on consulting agronomists, 12.5% on their own experience and neighbour. On the other hand, Özkan et al. (2003) stated that 49.7% of citrus producers in Antalya rely on their own experiences for selecting a particular pesticide, 42.8% rely on their vendors, 4% on Provincial/District Directorate of Agriculture and 3.4% on their neighbour. Dilmen et al. (2019) reported that 33% of farmers rely on vendors for agricultural pest control, 22% rely on Provincial/District Directorate of Agriculture and Forestry, 17% rely on their own experiences, 10% rely on their family, 9% rely on agricultural engineers and 1% rely on Chambers of Agriculture for technical knowledge while 6% do not seek any technical assistance.

Table 2. Awareness level of producers about who they get their pesticide advice from

Where do you get pesticide (fungus, herbicide and insecticide) advice?	Rate (%)
Vendor	25.50
District Directorate of Agriculture and Forestry	61.75
My experience and My neighbors	11.75
Consulting Agricultural Technician	1

When choosing (purchasing) pesticides (fungicides, herbicides and insecticides) used by walnut producers against diseases and pests, 10% considers their previous use, 40.50% considers the recommended active substance, 17% considers the brand and 32.50% take into

account the price (Table 3). İnan and Boyraz (2002) stated that 62.8% of the growers choose pesticides by taking into account the disease severity, 21.5% the spraying expenses and 15.7% the price; Boyraz et al. (2005) started that 78% of apple growers consider the severity of disease and pest, 11% price and 6% consider the spraying expenses as the main factors of selecting a particular pesticide; Erdoğan and Gökdoğan (2017) stated that 43.9% of producers choose pesticides based on trademark, 36.5% on price, 19% on effective ingredient and 0.6'% on expiration date; It was determined that 10% of the vineyard producers in Mardin chose the pesticide used against diseases and pests according to their previous use, 20.6% for the recommended effective ingredients, 28% for the trademark and 41.4% for price (Kaplan and Baran, 2021).

Table 3. Considerations when purchasing agricultural chemicals (insecticide, fungus and herbicide)

What to look for when buying a crop protection product (fungus, herbicide, insecticide)?	Rate (%)
Previous use	10
Recommended active ingredient	40.50
Brand	17
Price	32.50

It has been determined that 75% of the producers in Bitlis, which has a significant walnut production potential, do now no longer use the identical pesticide for the identical disease and pest, and 25% of them use the same pesticide all the time (Table 4. Erdoğan and Gökdoğan (2017) determined that 93.1% of the producers do not always use the same drug for the same disease and pest, while 6.9% of them use the same drug constantly. Kaplan and Baran (2021) reported that 63.5% of wine producers do not repeatedly use the same pesticide for the same disease and same pest, while 26.5% of them used same insecticide continuously.

Table 4. The knowledge levels of the producers about using the same pesticide for the same disease and pest

Do you always use the same pesticides for the same diseases and pests?	Rate (%)
Yes	25
No	75

Opinions of Producers on Determining the Time of Spraying

Walnut producers were asked how they decided on the time of spraying against pests and diseases in the walnut fields. 18% of the producers sprayed the diseases and pests at first sight, 44.4% according to the recommendations of the District Directorate of Agriculture and Forestry, 21.85% by asking their vendors, 12.25% before seeing the diseases and pests and 3.50% by following other producers (Table 5). Effective chemical management against diseases and pests are possible only by spraying at the right time. When spraying is done in this way, both the highest effect is obtained and it is economical. The answers given by the manufacturers on this subject are remarkable. Because 39% of them say that they apply pesticides when they first detect diseases and pests or in relation to their intensity. Accordingly, it can be considered that the producers know the diseases and pests and have the necessary technical knowledge, even if it is not sufficient. As a general information, it can be accepted that the spraying times made by considering the phenology of the plant are correct. However, when it is necessary to determine the spraying time and considering the biology of the disease and pest, it is not possible for the manufacturers to determine the spraying time correctly. This topic requires specialized knowledge and experience and can only be achieved through the training of dedicated staff. in studies similar to this, Yücel et al. (1995) stated that 42.15% of the producers rely on their own experiences, 9.80% are inspired by the people around them, 34.31% consult agricultural agencies and 13.72% consult their vendors for determining the spraying time. Üremiş et al. (1996), based on their study in Cilician plain, reported that 38.64% of producers rely on their own experiences and vendor recommendations, 35% rely on experiences, 19.09% rely on vendor experiences, 5.45% rely on technical agency recommendations and 1.82% rely on pesticide tag for determining the dosage and timing of the pesticide. Zeren and Kumbur (1998) reported that 40.18% of the producers rely on vendor recommendations, 29.92% rely on their own experiences and 16.23% rely on pesticide tag for determining the dosage and timing of the pesticide. İnan and Boyraz (2002) reported that 44.20% of the farmers in Konya rely on their own experience, 24.20% rely on vendor recommendations, 20% ask other producers and 11.60% consult agricultural agencies to determine the time of pesticide-use. After conducting a study in Tokat province, Kadıoğlu (2003) reported that 58.74% of the producers consulted the technical staff in deciding to spray, 29.14% decided on their own, 6.20% decided on the recommendation of their vendors and 81% consult other farmers. Boyraz et al. (2005) stated that 35% of apple growers decide on timing upon the first sighting of disease and pests, 22% based on early warning system; Kaplan and Baran (2021) reported that 17% of vineyard producers in Mardin decide on the timing upon first time seeing diseases and pests, 25% based on recommendations by the District Directorate of Agriculture and Forestry, 36% ask their vendor, 12% before any sighting of disease and pests and 10% follow other producers. In contrast to these findings, Karaçayır (2010) stated that 43.2% of apple producers in Karaman used pesticides before each pest sighting and 56.8% used pesticides after the first pest sighting.

It has been determined that 48.75% of the producers choose the pesticide dose in the chemical control of

Table 5. Walnut producers' knowledge levels about determining the time of disease and pest control in their orchards

How do you decide on the timing to spray for diseases and pests in walnut orchards?	Rate (%)
Vendor	21.85
District Directorate of Agriculture and Forestry	44.40
First sighting of pests and pests disease	18
Before sighting of any disease and pests	12.25
Follow other producers	3.50

pests in walnut production, according to their vendor, 41.75% according to the Provincial/District Directorate of Agriculture and 9.50% according to their own experience (Table 6). Özkan et al. (2003) expressed that 41.71% of citrus manufactures adjust their dosage according to the label and 27.81% adjusted dosage based on experience. Kalıpcı et al. (2011) found that 8.3% of Konya producers adjusted their pesticide doses according to the label, 26.6% adjusted it according to their own experience, 11.6% according to their neighbours, 33.3% according to the recommendations of their vendors, 10.8% said they adjusted according to District Directorate of Agriculture, 3.3% to Chambers of Agriculture and 5.8% to consultant Agricultural Engineer; Gedikli (2012) started that 33.33% of manufacturers advise with their vendors and Agricultural Engineers for dosage adjustment; Erdoğan and Gökdoğan (2017) expressed that 86.2% of the farmers consulted the vendor in the selection of pesticide dosage, 11.1% did it according to their own experience, 1.1% consulted the Provincial/District Directorate of Agriculture, 1.1% according to the private advisor and 0.5% according to their neighbour; Gözener et al. (2017) reported that manufacturers based their decisions on the recommendations of the pesticide-fertiliser vendors (90.28%), according to the label of the pesticide (59.72%), according to their own experience (40.28%), state/District Administration Advice on Agriculture, according to the recommendations of Forestry and Husbandry technical staff (1.39%) and according to disease intensity (1.39%) for adjusting the pesticide dose; Kaplan and Baran (2021) reported that in the chemical control of pests in the vineyards of Mardin, 68% of the producers consulted the vendor when adjusting the pesticide dose, 20.8% of them were told by the Provincial Directorate of Agriculture, 7.2% did it by their own experience and 5% followed their neighbours.

Table 6. The knowledge levels of the producers regarding the dosage adjustment of the pesticides they use

How do you adjust the dosage of pesticides (fungi, herbicides, insecticides)?	Rate (%)
Vendor	48.75
District Directorate of Agriculture and Forestry	41.75
Own Experience	9.5
Neighbour	-

The knowledge levels of the producers regarding the recommended pesticide dose were examined. It has been determined that 82.15% of walnut growers apply exactly the recommended dosage, and 17.85% apply a dose above the recommended dose (Table 7). The vast majority of manufacturers follow the recommended dosage. This should increase the likelihood of successful chemical control. In line with the results of this study, Tücer et al (2004) found that 72% of vineyard producers applied the recommended dose, 26% increased the recommended dose, and 2% applied it on visual basis; Peker (2012) reported that 88% of Konya growers used the recommended dose, 8% increased the dose, and 4% decreased the dose; Erdoğan and Gökdoğan (2017) reported that 50.7% of manufacturers used the recommended dose and 50.3% used a higher dose. It was determined that 87.8% of Mardin vineyard producers applied the recommended dose exactly, and 12.2% applied a dose above the recommended dose. Contrary to the results of this study, Boz et al. (1998) determined that 64.47% of the producers in Aydın used higher doses.

Table 7. Level of knowledge on recommended doses of pesticides

Are pesticides (fungicides, herbicides, insecticides) used at recommended doses?	Rate (%)
Recommended dose	82.15
Over the recommended dose	17.85

In Bitlis (Adilcevaz and Hizan), 57.14% of walnut growers reported that pesticides leave residues in their products, 39.28% left little residue and 3.58% stated that they did not leave any residue in the product (Table 8). In Antalya, 70.4% of manufacturers said pesticide residues remained in their products, 10.4% said the pesticide residues disappeared when washed, and 19.2% did not know; 34.3% of manufacturers indicated that pesticides may leave residues in their products, 23.8% of them indicated that each pesticide leaves residues, and 18.1% of manufacturers use recommended doses. 13.4% of them said that the residual effect disappeared after cleaning and 10.4% said that no pesticide remained at all but 28.3% of Konya growers said pesticides could remain in their products, 18.3% said they did not leave residues, 7.5% said they did not know and 45.8% said pesticides were washed away by rain. said to be; 38.7% of almond growers in Adıyaman say they have pesticide residues in their products, 32.3% stated little residue is left and 29% stated that they did not leave any residue on the product. In Tokat Kazova, 44.44% of tomato growers reported that pesticides left residues in their products, 15.63% reported that pesticides were used above doses left residues, and 15.63% said all pesticides, they reported leaving a residue, and 9.38% reported having a residue. No residue when used at recommended dose (Özkan et al., 2003; Karaçayır, 2010; Kalıpcı et al., 2011; Gözener et al., 2017, Erdoğan et al., 2017). Contrary to the results of this study, exports

that 80% of the manufacturers have not reported pesticides, and 20% have observed the residue. Erdoğan and Gökdoğan (2017) is 74.1% of producers stated no residue from pesticides, 23.8% stated minimal residue while 2,1% stated significant amounts of residue.

Table 8. Knowledge level of producers about the pesticides leaving remain on the products

Did you know that pesticides remain in products?	Rate (%)
They do leave residue	57.14
Minimal residue	39.28
No residue	3.58

53.58% of the producers using pesticides in Bitlis (Adilcevaz and Hizan) reported that they observe the latency of pesticides, 32.14% do not observe the waiting times and 14.28% observe it from time to time (Table 9). It is an effective component that the extensive majority of manufacturers pay attention to the waiting time. Boyraz et al (2005) found that 71% of apple growers respect waiting times between spraying and harvesting, while 29% do not, Erdoğan and Gökdoğan (2017) found that 80% of potato farmers respect the waiting time between spraying and harvesting, 20% do not respect the waiting time. Contrary to the results of this study, Emeli (2006) stated that 76.6% of the producers do not comply with the waiting period after spraying, while 23.4% of them comply with the waiting period; According to Karaçayır (2010), 43.2% of producers respect waiting time, 32.8% know waiting time but do not respect waiting time, and 24% do not know waiting time. Gözener et al (2017) stated that 91.67% of the growers do not know the time required between the last spraying and harvest, 6.94% know but do not apply, and 1.39% know and apply the waiting time; Kaplan and Baran (2021) reported that 88.6% of vineyard producers using pesticides in Mardin pay attention to the waiting time in pesticides, and 11.4% do not.

Table 9. Knowledge level of growers about the time between spraying and harvest

Do you comply with the waiting period for pesticides?	Rate (%)
Yes	53.58
No	32.14
Sometimes	14.28

60.73% of walnut producers in Bitlis (Adilcevaz and Hizan) stated that they use protective clothing and masks while applying pesticides, 21.42% sometimes use them and 17.85% never use them. It has been determined that more than half of the walnut producers comply with the protection measures during spraying and show sufficient care (Table 10). Similar to the current findings, Özkan et al. (2003) reported that 68.8% of producers use protective clothing and mask when applying pesticides while 31.2% never use any; Bayhan et al. (2015) reported that he 76% of producers had protective measures in place and 24% did not. Contrary to the results of this study, Tücer et al. (2004) sarted that 57.82% of farmers used protective clothing and masks when applying pesticides, and 42.18% did not use them at all; Erdoğan and Gökdoğan (2017) stated that 84.7% of producers use protective clothing and mask when applying pesticides while 15.3% never use any. Kaplan and Baran (2021) reported that 48% of vineyard producers in Mardin use protective clothing and mask when applying pesticides, 16% rarely use them while 36% never use any.

Table 10. The knowledge level of the producers about the precautions to be taken when applying pesticides

How do you protect your health when applying pesticides? (Using protective clothing, mask, goggles and gloves during treatment)	Rate (%)
I always use	60.73
I sometimes use	21.42
I never use	17.85

Walnut producers were asked what they do with empty pesticide boxes after use. It was determined that 2% of the participants wash and reuse, 3.25% bury them in the ground, 38% throw them away, 27.15% burn them and 29.6% randomly throw them into the environment (Table 11). In studies conducted on the subject, it has been determined that producers exhibit different behaviours about empty pesticide container. Özkan et al. (2003) stated that 70.45% of manufacturers burn empty boxes, 21.81% throw them away, 14.36% bury them in the ground and 7.45% throw them into the environment; Tücer et al. (2004) reported that 60.54% of manufacturers indiscriminately throw away empty boxes, 4.98% use them for other purposes, 19% bury them, and 15.48% burn them; Ertürk et al (2012) stated that 35.6% of growers bury empty boxes in the ground, 34.6% throw them in the orchard, and 29.8% throw them in the garbage. Akbaba (2010) stated that 61.1% of Çukurova producers store their empty boxes in a designated place before burning them; Karataş and Alaoğlu (2011) stated that 65.3% of wine producers burned empty boxes, 24% threw them at random, and 10.7% buried them in the earth.; With respect to Erdoğan and Gökdoğan (2017), 68.3% of producers burn empty boxes, 16.4% bury them, 13.8% indiscriminately discard them, and 1.5% wash and reuse them. Gözener et al (2017) stated that 59.72% of manufacturers burn empty boxes, 29.17% bury them in the ground, 5.56% dispose of them in the same bins as household waste, and 5.56% discriminately dispose of them in the environment. In Mardin, 2% of vineyard producers are reported to wash and reuse empty pesticide boxes after usage, 15.6% bury them in the ground, 20% throw them away, 24.3% burn them, and 38.1% randomly throw them away (Kaplan and Baran, 2021),

Table 11. Knowledge level of producers on empty pesticide boxes

What about pesticides (fungi, herbicides, pesticide boxes)?	Rate (%)
Wash & re-use	2
Bury	3.25
Thrash	38
Burn	27.15
Throw Away Randomly	29.6

It has been determined that 85.75% of walnut producers clean their tools after pesticide, 10.75% sometimes clean, 3.5% never clean (Table 12). It was determined that 85.42% of the grape growers in Manisa wash their insecticides after spraying with pesticides, while 14.58% do not wash the pesticide machine; 69.2% of the producers in Iğdır are reported to clean the pesticide machine after usage, %27.9 sometimes clean it and 2.9% never clean it; 95.8% of potato producers are reported to clean their pesticide tool after usage while 4.2% do not clean; 90.3% of almond producers clean the tool after usage, 6.5% do not clean it while 3.2% sometimes clean it; 78.3% of vineyard producers clean the tool after usage, 14% sometimes clean it and 7.7% do not clean it (Tücer et al. 2004; Ertürk et al. 2012; Erdoğan and Gökdoğan, 2017; Erdoğan et al., 2017; Kaplan and Baran, 2021).

Table 12. Knowledge levels of producers about cleaning pesticides after use

Do you clean the sprayer after pesticide?	Rate (%)
Yes	85.75
Sometimes	10.75
No	3.5

32.5% of walnut producers reported that they use pesticides in a mixture, 22.85% use it sometimes by mixing, and 25% use it without mixing at all (Table 13). Similar to those results, Boyraz et al. (2005) 83% of apple growers make a mixture of pesticides, while 17% do not mix them; Reported by Peker (2012) that 56% of producers use mixed pesticides, 24% of producers do not use mixtures, and 20% sometimes mix them; Erdoğan and Gökdoğan (2017) stated that 56.1% of farmers used mixed pesticides and 43.9% used pesticides unmixed. Erdogan et al. (2017) expressed that he 78.5% of almond growers use mixed pesticides., 19.4% sometimes mix them and 2.1% use them without mixing at all; Kaplan and Baran (2021) reported that 56.5% of those engaged in vineyard production use pesticides in a mixture, 16.5% use it sometimes with mixing, and 28% use it without mixing at all.

57.2% of the producers apply chemical control, 18.3% cultural control, 6.7% mechanical control, 2% physical control, 12.8% biotechnical control methods and 2.62%

Table13. Knowledge level of producers about mixing pesticides

Do you mix pesticides?	Rate (%)
I mix them	32.15
I mix them sometimes	42.85
I do not mix them	25

of them stated that they do not apply any control methods (Table14). Similar to these findings, it is stated that 88.4% of the producers apply cultural control, 10.5% mechanical control and 1.1% physical control methods other than chemical control (Erdoğan and Gökdoğan, 2017). It has been stated that 71% of vineyard producers apply chemical control, 12.9% apply cultural control, 8% apply mechanical control, 5% apply physical control and 3.1% apply biotechnical control methods (Kaplan and Baran, 2021). Contrary to these results have been reported that 43.58% of the producers in Tokat prefer cultural control, 33.33% prefer mechanic control and 23.07% prefer physical control in addition to chemical control (Kadıoğlu, 2003).

Table 14. Knowledge level of producers about disease, pest and weed control methods

Methods of controlling pests, diseases and weeds	Rate (%)
Chemical control	57.2
Cultural control	18.3
Mechanic control	6.7
Physical control	2
Biotechnical control	12.18
Biologic control	-
None	2.62

92.85% of walnut growers say they are unfamiliar with the term biopesticide, and 7.15% stated that they know the concept of biopesticide (Table 15). In parallel with our research results, Erdoğan et al (2017) stated that 78.5% of almond farmers do not know the concept of biopesticides, and 21.5% of them know the concept of biopesticides in agricultural control. In another study conducted by Erdoğan and Gökdoğan (2017), reportedly, 97.4% of manufacturers are unfamiliar with the term biopesticide, while 2.6% are familiar with the term biopesticide. Kaplan and Baran (2021) reported that 96.5% of the vineyard producers did not know the term biopesticide, while 3.5% of them stated that they knew the concept of biopesticide. Contrary to these results, 52% of GAP manufacturers (South-eastern Anatolia Project) region already heard about the term biopesticide while %48 never heard of it (Bayhan et al., 2015). Most walnut growers in Bitlis are owned by state/provincial agricultural departments and their vendors, farming organizations and and their vendors, the agricultural organization and

Table 15. Knowledge levels about the term biopesticide

Do you know biopesticides?	Rate (%)
I do not know	92.85
I do know	7.15

its vendors have important duties in biopesticides and biological control.

CONCLUSION

Plant protection has an important place in agricultural production. Due to the intensive use of pesticides in walnut production areas, this survey study was conducted to determine plant protection problems in the walnut areas of Bitlis province. As a result of the study, the precautions taken by the producers when faced with plant protection problems, the people they consulted were determined and it was determined what they paid attention to in the selection and use of agricultural pesticides and spraying machines. Within the scope of the study, the problems in the use of plant protection products in walnut production areas were determined, and attention was drawn to the work on the solution of the problems and the solutions.

At the end of the study, it was determined that the producers in Bitlis (Adilcevaz and Hizan), which has a significant walnut production potential, prioritize chemical control in the fight against existing diseases and pests in order to obtain efficient and quality products. As a result of the random and unconscious use of pesticides, both human and environmental health are affected, and it is possible for diseases and pests to develop resistance to pesticides over time. For this reason, an effective, economical and environmentally friendly control method can be employed by using more suitable pesticides in order not to be exposed to undesirable side effects.

In conclusion, it will be beneficial to give importance to integrated control against main diseases and pests in walnut fields, and to use selective pesticides that are relatively safe for human and environmental health in cases where chemical control is inevitable. In this way, pesticide residues, if practices that reduce the use of chemical pesticides are preferred and pests will be prevented from gaining resistance to pesticides, and there will be a certain level of reduction in production costs. For these reasons, it is very important to make sustainable agricultural production in a way that will reduce the possible negative effects of agricultural control activities on the agroecosystem and biological balance.

COMPLIANCE WITH ETHICAL STANDARDS

Conflict of interest

The authors declared that for this research article, they have no actual, potential or perceived conflict of interest.

Author contribution

The contribution of the authors to the present study is equal. All the authors read and approved the final manuscript. All the authors verify that the Text, Figures, and Tables are original and that they have not been published before.

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Ethics committee approval is not required.

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