



THE ECONOMIC REVENUE OF ADOPTING THE INTEGRATED PEST MANAGEMENT PROGRAM FOR PALM TREES IN IRAQ (KARBALA GOVERNORATE: AS A CASE STUDY)

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Abstract:

The research aimed to calculate the economic return of adopting the integrated pest management – IPM program for pests that affect palm trees from the economic perspective, by measuring the impact of its application on some economic variables (total costs, average production, and net profit) per donum which is a quarter of a hectare. The results showed that the application of IPM positively impacts the average production, as it reached the levels of application (low, medium, and high) of about (1647, 2161.3, and 1798.5) dinars/ donum respectively. As well as the positive impact in reducing costs, the results showed that the costs for the same application levels amounted to (177897, 171362, and 122109) dinars/ donum respectively. Also, the net profit has been positively affected by the program on farmers who apply the program in a medium and high manner compared to those who apply it low. The results showed that the net profit amounted to (61945, 97104, and 100599) dinars/ donum respectively. The research recommended increasing support for programs using modern control methods in control to reduce costs and protect the environment, as well as increasing financial support for the integrated pest management program in Karbala Governorate and extension programs in the field of eco-friendly control.

Keywords: IPM, adoption, net yield, date palm, eco-friendly pesticide

INTRODUCTION :

Economic resources and their productive data represent the economics cornerstone of the agricultural development, also the economic use of those resources represents one of the main goals of economic growth (Kadhim et al., 2019,263). The importance of date palm fruits in the Iraqi economy is evident by attracting an important percentage of the workforce practicing date palm cultivation and the production and marketing of its many fruits and products (Al-Qaisi, 2002,7). Dates are a good source of thermal energy and many essential mineral salts for the human body, such as iron, calcium, magnesium, sulfur, and some vitamins, in addition to the use of dates in many manufacturing industries (Kadhim et al., 2013,293). They constitute a large proportion of Iraq's agricultural exports. It represents 60%-80% of it for the period (2008-2010), as the situation of date production has improved in recent years as a result of the state's interest in this vital sector represented in the agricultural initiative and the control campaigns implemented by the Ministry of Agriculture for epidemic pests that affect palm trees such as the palm Dubas bug and Lesser date moth (Humaira) (Al-Wasiti et al, 2023,208). Iraqi date exports come in second place in the value of Iraqi exports, after oil. A study recommended the necessity of diversifying sources of national income in the local economy, by profiteering all available resources, with the aim of reducing dependence on oil revenues, which constitute a major source of financing imports in the country (Kadhim, 2022,185).Date palms are used in many local industries such as furniture, household appliances and other tools. Rayon was produced from date palm fronds taken from date palm trees from Iraqi orchards (Zahdi type) (Mahdi et al, 2018,1049). The geographical concentration of the quantitative production of dates in Iraq indicates the concentration of the



quantities produced of dates in a large proportion in the central region of the country (Al-Badri, 2015,270). The country's development plans have emphasized meeting the increasing demand for agricultural commodities with various decisions to ensure the success of this goal (Al-Huseini, 2012,77).

The Methodology of Research & previous studies

The Methodology of Research :The last thirty years have witnessed a significant expansion in agricultural pest control activities that attack various crops and thus protect them from pests using Agricultural chemicals (pesticides and industrial growth regulators) are not due to the economic pressure that these materials exert on the inputs of the production process for this subject, but because of the growing concern about the safety of the environment and public health, especially after the development of chemical detection methods for the residues of these chemicals, as man suddenly found himself in an environment with all its elements of water, air and soil contaminated with the residues of these materials, which led to the threat of the existence of many plant and animal communities, and this threat may directly affect the human community itself if as a result of this concern, interest in using the natural inputs of the agricultural production process increased to ensure that the outputs are safe and affect the general environment.

Research Importance :The importance of the research is evident from the interest of the Ministry of Agriculture in programs to control crops pests reducing their impact to increase and improve agricultural production and work to spread modern methods, and the adoption of an integrated policy of integrated control of agricultural pests that affect the main crops, in addition to working to reduce the use of chemical pesticides and avoid the damage they cause to the environment and human health, which contributes to a qualitative leap in agricultural production in quantity and quality.

Research Objectives:The research aimed to measure the impact of the application of integrated pest management using agricultural operations and alternatives to agricultural pesticides in the control of palm pests and diseases on some economic variables represented in net profit, average productivity, and average costs (in donum).

Research hypothesis

1. There are significant differences between the categories of orchard owners who applied the program and those who did not apply the program.
2. The cost of the integrated agricultural pest management program negatively affects the adoption rates of the program, while the net disposable profit positively affects the adoption rate.

Limitations :Primary data were obtained through a field survey using a questionnaire prepared for this purpose. Karbala governorate was chosen as a location to conduct the study, as it is considered one of the first governorates in terms of the number of palm trees, which is estimated at 1.34 million palm trees (Al-Qaisi, 2002,7). The stratified sampling method was used, as the community was divided into homogeneous sections known as classes, then a random sub-sample was chosen whose size was proportional to the size of the class. This method is called the relative specialization method (Al-Rawi, 1979, 232), as 118 farmers were surveyed in Karbala governorate for the year 2022, and the sample included all people. The agricultural units implementing the integrated palm pest control program in Karbala, which are (Al-Husseiniyah, Aoun, Al-Markaz, Al-Hindiyah and Al-Jadwal Al-Gharbi).



Research method :The research relied on the method of linking between quantitative analysis, which is based on econometric methods and descriptive analysis, which is based on the concepts of economic theory in line with the research objective, and the statistical program (SPSS 26) was used in analyzing data related to estimating the regression relationship according to the concepts of economic theory and statistical tests, and standard quantitative analysis was used as a method to determine the appropriate mathematical models after describing and identifying them and choosing the best among them and what is consistent with economic theory, and to achieve the objectives of the research, a questionnaire form was prepared and designed through it to see the recommendations of the integrated pest management program with workers in the integrated palm pest management programs, and its data was collected through a personal interview for the members of the research sample in Karbala governorate. The data has been coded and dumped into Excel tables, and statistical processing was carried out using the statistical program Eviews, where several statistical methods were used, represented in, percentages, frequencies and arithmetic mean, and measuring the regression relationship between the variables in the study sample. As well as the use of the triple Likert scale distinguishes farmers according to the level of application recommendations for agricultural operations and pest control recommendations with alternatives to agricultural pesticides into three categories, the first category is a low level of application, the second category is a medium level of application and the third category is a high level of application and using the method of dummy variables to identify differences between different levels of application.

Study data and sample :Research data was collected from the following sources:

- Official sources are rare, represented by the Ministry of Planning, the Central Bureau of Statistics, the Ministry of Agriculture, the Directorate of Agriculture of Karbala and its agricultural departments.
- Questionnaire, where a questionnaire form was prepared to collect data related to this activity, and some data was collected for the purpose of clarifying the terms of the form and questions, knowing the response of farmers and their reactions, and then preparing them in their final form.

The raw data were obtained from the field survey of a questionnaire prepared for this purpose. Karbala Governorate was chosen to conduct the study, as it is one of the main provinces in terms of palm trees, estimated at 1.3 million palm trees (Ministry of Planning, 2021,17).The stratified sample method was used, as the community was divided into homogeneous sections, then a random sub-sample was selected whose size is commensurate with the size of the class, and this method is called the method of relative specialization (Al-Rawi, 1979,233), as 118 farms were surveyed in Karbala Governorate for the year 2022. The sample included all agricultural divisions implementing the integrated management program for palm pests in Karbala Governorate, namely (Husseiniya, Aoun, Markaz, Hindiya and Al-Jadwal Al-Gharbi).

previous studies

(Githiomi et al, 2019,129) studied 'Economic analysis of the indirect effects of an integrated pest management (IPM) strategy to suppress fruit flies in Kenya' This study presented an analysis of the indirect effects of an IPM strategy on gross margins of avocado, citrus, papaya and banana grown by smallholder farmers in Meru County - Kenya. Data on 371 households obtained from a field survey of beneficiaries of IPM programs were analyzed. The adoption of IPM increased average gross profit margins for citrus and papaya by approximately 38% and 27% respectively per year per hectare.

(Abdullah, 2021,1072) studied 'The economic return of applying the technical recommendations of the integrated management of banana pests' program' with the aim of studying the economic return of integrated pest control in resisting pests that affect the banana crop in Menoufia governorate of Egypt, by measuring the effect of applying agricultural practices and practices of controlling banana pests with pesticide alternatives. on some variables, in addition to monitoring and analyzing production and marketing obstacles, and obstacles related to pest control in the study sample. The results of the study showed the positive impact of applying the integrated pest control program on acreage productivity, acreage return, total profits, and total costs.

(Singh and Singh, 2007,81) study 'Economic Evaluation of Pest Management Techniques for Sustainable Cotton Production in Punjab' This study was undertaken to make cotton production in the Indian state of Punjab globally competitive by reducing the cost of production at farm level through adopting new pest management techniques, namely, Integrated Pest Management (IPM) and Insecticide Resistance Management (IRM). The study revealed that adopters of IPM and IRM technology could receive significantly higher yields compared to non-adopters, and IPM and IRM technologies reduced pesticide consumption by 67% and 54%, respectively. Cost-benefit analysis showed that these technologies are economically viable.

(Sanglestsawai et al, 2015,155) study 'Economic Impacts of Integrated Pest Management (IPM) Farmer Field Schools (FFS) Evidence from Onion Farmers in the Philippines' This study comprehensively examines the impact of IPM - Farmer Field Schools (FFS) on yield and pesticide expenditures Insects, labor expenses, herbicide expenses, fertilizer expenses and profits, based on data from onion producers in the Philippines. The study finds that more efficient use of all inputs is likely to reduce total expenses, and ultimately translate into increased income.

IPM impact on some economic variables

This part of the research is concerned with identifying the impact of the application of chemical pesticide alternatives and agricultural practices in palm pest control on some economic variables represented in (average productivity, net profit, and average costs/ donum). The formal variables were used in the formation of the regression model between the explanatory qualitative variable (application level) and the dependent variable (average productivity, net profit, and average total costs/ donum). When testing the impact of the level of application of IPMs on one of the above-mentioned dependent variables of a crop, the relationship is as follows (Attia, 2005,260):

$$W = B_1 + B_2D_2 + B_3D_3 + U$$

W = quantitative dependent variable.

D₂ = 1 The farmer is of medium application level.

D₂ = 0 farmer with another application level.

D₃ = 1 cultivator with low application level.

D₃ = 0 farmer with another application level.

U = random error.

Table 1. Distribution of the applied level of IPM

Application level	D ₁	D ₂	D ₃
Cultivator with low application level	1	0	0
Farmer with medium application level	0	1	0
Farmer with high level of application	0	0	1

Source: Prepared by the researchers.

Since the intersection parameter B_1 is the value of the dependent variable (W) when all the explanatory variables listed by the function = zero, that is, when $=D_2$ zero, $=D_3$ zero, then it represents the value that the dependent variable (W) takes when $= D_1$ and is called the base parameter. Therefore, there is no need to write (D_1) as a third variable because it accompanies the carrier parameter and its value is one. The derivatives of the function are obtained as follows:

$$W = B_1 + B_2D_2 + B_3D_3 + U$$

B_1 : Expected value of the dependent variable relative to the degree of low application.

B_2+B_1 : Expected value of the dependent variable relative to the degree of application Mean.

B_3+B_1 : Expected value of the dependent variable relative to the high degree of application.

Agricultural pests and damage caused by them

The concept of a pest from the human point of view is any living organism that exists in an inappropriate place, just as the rose bush is considered a bush if it is found in a field of humiliation, and the organism may be a pest under the ether of a group of circumstances, while it is not a pest under other conditions or cases, so the butterfly called the decorated lady Painted Lady in Britain may be considered something beautiful and always cheerful, but in France, it is considered a pest and in North America it is considered a factor in life control or biological to some thorns, so from a human point of view this butterfly is only a pest in Francis (Ismail, 2009,11).

Pests affecting agricultural crops cause significant economic losses to farmers, with FAO estimating that plant pests and diseases are responsible for a 20-40 percent reduction in global crop yields annually. Crop losses contribute to food insecurity, which continues to grow as populations increase in the face of climate challenges. Recent research strongly suggests that crop yields may decline due to climate change and changing weather patterns. It is also likely that climate change is making plant pests more harmful to crops in terms of intensity, distribution and spread (FAO, 2023).

The use of pesticides causes many problems that are reflected in ecosystems. Research studies carried out by international organizations and bodies concerned with chemicals have proven that many agricultural pesticides have caused cancerous tumors on humans, in addition to causing other side effects of congenital malformations resulting from the accumulation of pesticides in small quantities and for long periods of time (Al-Hasani, et al, 2012,72).

Palm IPM in Iraq

The control of agricultural pests that threaten agricultural production is one of the most important topics of interest to those responsible for agricultural production in Iraq, as it leads to serious losses in production in quantity and quality, and agricultural pesticides have been one of the most important means of combating these pests, which have achieved great success in eliminating them, but after years of using these pesticides, they have had negative effects on human health and the environment in which they live, killing natural enemies and beneficial insects, and polluting water and soil. The world has recently been interested in designing integrated control programs that do not depend on the use of pesticides, but rather rely on the use of other means such as encouraging the reproduction of parasitoids and predators in the environment, the use of some types of bacteria to cause insect infections, the use of insect traps containing sexual attractants, the cultivation of varieties resistant to diseases and insects, the care of land service, the disposal of insects and other agricultural and mechanical operations. and vitality that limits insect infestation (Yosef and EL-Sayed, 2008,200). FAO has defined integrated management as "a comprehensive ecological approach to pest control using different continuous techniques in the system for pest control". In another definition, IPM is the adoption of the advantages of each method of resistance to reach complete protection of agricultural crops and complete eradication of pests of all kinds (Bassiouni, 1993,8). Abdul Hamid and others knew that integrated control

means creating environmental conditions so that it looks inappropriate for the pest by either disrupting its reproductive capacity, getting rid of its food host, or creating appropriate conditions for its vital enemies to eliminate it (Abdel-Hamid and Abdel-Meguid, 1994,46). Integrated pest management has also been defined as "a system of control and control of the number and damage of pests through the use of all means of control from agricultural, mechanical, legislative and biological control in addition to chemical control that is used in the narrowest limits, and in a thoughtful consensus to achieve the highest desired result in the economic, social and environmental aspects" (Hassan, 2000,18). Integrated management from this point of view means the use of all possible methods of control of insect pests to reduce or eliminate them while preserving the elements of the environment without defect or damage to them, taking into account social habits and natural, economic and cognitive conditions of farmers in order to achieve the highest possible benefit with the least possible harm to humans and their environment, which He lives in them. Many studies have shown the importance of using integrated pest management as an alternative to traditional control, as it has achieved many successes in terms of the environmental and economic aspect.

(Al-Jamali and Al-Kriti, 2015,36) others concluded that solar energy traps are the best in attracting excavator adults and therefore can be used to monitor and control palm excavators and reduce their numerical density.

In another study, the efficiency of the use of bio-pesticides in the control using the bio-pesticide (BT), which was used by spraying and fogging method, was shown. The results of the study showed the effectiveness of bio-pesticides in reducing the damage of Lesser date moth (Mohammed et al, 2013,223). In a study conducted to diagnose the pest of palm tree borer, the treatment of the heart of the palm with preparations of fungi *Metarhizum anisopliae* and *Beauveria bassiana* caused a reduction in the damage caused by the insect on the offshoots and that the duration of the survival of the fungus on the treated offshoots exceeded 7 months and the fungus *Metarhizum anisopliae* may exceed in its efficiency (Al-Saeedi, 2015,128).

The recommendations for integrated palm pest management include some agricultural practices that take place during crop production, which leads to the lack of appropriate environmental conditions for the reproduction of pests on palm trees, as well as some alternatives to chemical pesticides as shown in the Table 2.

Table 2. Recommendations for the Integrated Pest Management Program

Agricultural practices	Objective
Takrib (local name)	Remove the old fronds that have stopped doing their job due to their aging. The pinching process also includes the removal of thorns and cutting anguish
Orchard cleaning during the season	Remove residues and infected fruits during the season
Cleaning the orchard for the previous season	Removal of residues and infected fruits of the previous season
Fertilizing the orchard	Use of organic, chemical or biological fertilizer
Watering using modern methods	The use of modern irrigation methods and according to the recommendations of the program
Taste bagging	Wrapping the taste with special bags open from the top and from the bottom
Pesticide alternatives	Objective
Light traps	To combat pest excavators
Environmentally friendly pesticide	To combat the pest of rubella
Pheromone traps	To combat the pest of rubella
Environmentally friendly pesticides	To combat dust dream pest (spiders)
Environmentally friendly pesticides	To combat the pest of Dubas

Source: Prepared by the researchers.

The triple Likert scale was used for farmer excellence according to the level of application of the recommendations on agricultural practices and pest control with alternatives to chemical pesticides into three categories (high level of application, medium level of application and low level of application), and includes the integrated program for the management of date pests in Iraq on eleven recommendations related to control using chemical pesticide alternatives and agricultural practices, the respondents were asked to answer a statement of three responses (yes, not every year and no) and the grades were given 1, 2, 3 degrees on The ranking, therefore, the maximum degree of application was 33 degrees, then the degrees of the respondents were collected for each of the control using chemical pesticide alternatives, agricultural practices and the total degree, and thus the respondents were divided into three categories according to the level of applications.

RESULTS AND DISCUSSION

Integrated control using agricultural practices

Understanding complex interactions in the ecosystem can play an important role in pest management, and risks are a phenomenon associated with agricultural production and cannot be eliminated, but can be reduced or coexisted with minimal damage (Zaidan et al, 2023,10). Decision making in pest management requires a thorough analysis of the agricultural ecosystem, so the farmer must learn how to monitor the crop (Satyagopal et al, 2014,50). The results in Table 3 indicated which it is concerned with the frequency distribution, weighted average and level of application of farm practices for the date crop, which were arranged in descending order according to the weighted average, showing that phrase No. 1 came in the first place related to (Takrib) is one of the important operations in palm plantings that include the removal of the old fronds of previous years, which is not useful for the palm in addition to the removal of the rooks and fibers with a weighted average of 2.50, and a high level of application, and came in second place phrase No. 2 cleaning the orchard during the season with a weighted average of 2.42, With a high level of application, either statement No. 3 came in third place, which is (cleaning the orchard for the previous season) with a weighted average of 2.32, with an average application level, and in fourth place came phrase No. 4 (fertilizing the orchard) with an average of 2.07 with an average level of application, while the fifth place for phrase No. 5, which relates to (irrigation using modern methods) with a weighted average of 1.28 with a low level of application, while the sixth and last place for statement No. 6 (bagging for taste: with cloth or plastic bags) with a weighted average of 1.23 with a low level of application.

While the average application of the total agricultural technical practices was about 1.97 with an average application level for the total study sample.

Table 3. Application of IPM

Integrated management (agricultural operations)	Yes	%	Not every year	%	No	%	Weighted average	Arrangement	Applying level
Dedication	66	55.9	45	38.2	7	5.9	2.50	1	High
Cleaning during current season	60	50.8	48	40.6	10	8.4	2.42	2	High
Cleaning in previous season	53	44.9	50	42.4	15	12.7	2.32	3	Medium
Orchard fertilization	38	32.2	51	43.2	29	24.6	2.07	4	Medium
Irrigation using modern methods	17	14.4	0	0.0	101	85.6	1.28	5	Low
Diet wrapping	6	5.1	16	13.5	96	81.4	1.23	6	Low
(Total, average) Farm practices	240	33.8	210	29.6	258	36.4	1.97	-	Medium

Application level: low (1 – 1.76), medium (1.77 – 2.33), high (2.34 – 3).

Source: Collected and calculated by the authors based on the questionnaire.

IPM using alternatives of chemical pesticide

The results contained in Table 4. which is concerned with the frequency distribution, weighted average and level of application for integrated control using alternatives to agricultural pesticides for palm pest control, which were arranged ascending according to the weighted average, showed that statement No. 1 ranked first related to (light traps) with a weighted average of 1.36 and a low level of application, and statement No. 2 came in second place related to (environmentally friendly pesticide to control Lesser date moth). with a weighted average of 1.96 and an average application level, while statement No. 3 came in third place related to (pheromone traps to control Lesser date moth) with a weighted average of 2.11 and an average level of application, statement No. 4 came in fourth place related to environmentally friendly pesticides to control dust spider pest with a weighted average of 2.44 and a high level of application, while statement No. 5 came in fifth place related to (eco-friendly pesticides to control the pest of Dubas) with a weighted average capacity 2.55 and high application level. While the average application of integrated management using alternatives to agricultural pesticides was about 2.08 with an average application level for the total study sample.

Table 4. Level of Application of IPM

Integrated control	yes		Not every year		no		weighte d average	Arran- gemen t	Applying level
	yes	%	%	%	%	%			
Optical trap	9	7.6	25	21.2	84	71.2	1.36	5	Low
Eco-friendly pesticide to control Lesser date moth	35	29.6	37	40.7	29	31.9	1.96	2	Medium
Fermon traps to control Lesser date moth	41	34.7	50	42.4	27	22.9	2.11	1	Medium
Eco-friendly pesticides to combat dust spider	22	18.6	60	50.9	36	30.5	2.44	4	High
Eco-friendly pesticides to control Dubas bug	25	21.1	58	49.1	35	29.6	2.55	3	High
Total expulsion practices	132	22.32	230	40.8	211	37.2	2.08	-	Medium
				6		2			

Application level: low (1 – 1.76), medium (1.77 – 2.33), high (2.34 – 3).

Source: Collected and calculated by the authors based on the questionnaire

Farmer classification

Table 5. shows the classification of respondents according to the categories of the level of application of agricultural operations and palm pest control practices for the study sample, the high level of application 26-33 degrees came in third place by 8.79% of the total farmers of the sample, the level of medium application 19-25 degrees came in first place by 60.43% of the farmers of the study sample, while the low level of application 11-18 degrees came in second place by 30.67% of the farmers of the sample.

Table 5. Farmers according to the level of application of IPM

Order	%	Iteration	Application level
1	60,16	71	Average (19-25)
2	30,50	36	Low (11 - 18)
3	9,34	11	High (26 - 33)
-	100	118	Total

Source: Collected and calculated from sample data.

The relationship between productivity and degree of application

By estimating the regression relationship between the average productivity per donum as a dependent variable, and the level of application of integrated management using chemical pesticide alternatives and agricultural processes in pest control as an independent variable in Karbala Governorate. Table 6. shows that the statistical significance was established at the level of 1% for the estimated regression relationship, the average productivity of the low application level was about 1647 kg/ donum, and this was achieved for about 30.5% of the sample farmers, and the average application level was about 1798.5 kg/ donum, and it was found that about 60.16% of the sample farmers fall into this category, while the average productivity was about 2161.26 kg/donum for the high-application category, which represents about 9.34% of the sample farmers. The positive impact of the application of integrated management using alternatives to chemical pesticides and agricultural operations in palm pest control is also evident on the average productivity of the date crop in the study sample, where the high application ranked first in the average productivity, while the average application came in second place, and the low application came in third place.

Table 6. Estimation of Application IPM

Period		Function	N. of Farmers	F
Productivity (kg)	Over all function	$\hat{Y}_t = 1647 + 151.52 D_2 + 514.26 D_3$ (243.2)** (1.876)* (4.35)**	118	
	Low applying level	$\hat{Y}_{t1} = 1647D_1$	36	6.55**
	Medium applying level	$\hat{Y}_{t2} = 1798.52D_2$	71	
	High applying level	$\hat{Y}_{t3} = 2161.26D_3$	11	
Cost of each Donum (IQD)	Over all function	$\hat{Y}_t = 177897 - 55787.3 D_2 - 6534.6 D_3$ (9.89)** -(2.32)** -(1.8)*	118	
	Low applying level	$\hat{Y}_{t1} = 177897D_1$	36	6.92**
	Medium applying level	$\hat{Y}_{t2} = 122109.2D_2$	71	
	High applying level	$\hat{Y}_{t3} = 171362.4D_3$	11	
Profit of each Donum (IQD)	Over all function	$\hat{Y}_t = 61945.7 + 35158.7D_2 + 38653.8D_3$ (9.25)** (1.68)* (2.17)*	118	
	Low applying level	$\hat{Y}_{t1} = 61945.7D_1$	36	6.76**
	Medium applying level	$\hat{Y}_{t2} = 97104.4D_2$	71	
	High applying level	$\hat{Y}_{t3} = 100599.5D_3$	11	

Source: Collected and calculated by the researchers using the data of the questionnaire.

Where:

D_2 = zero if the farmer has another application level.

D_3 = zero if the farmer is of another application level.

\hat{Y}_t = estimated value of the phenomenon.

D_2 = 1 if the farmer has an average application level.

D_3 = 1 if the farmer has a high level of application.

*Significant at 5%.

** significant at 1%.

Total costs application relationship

By estimating the regressive relationship between the total costs/ donum as a dependent variable, and the level of application of integrated management using alternatives to chemical pesticides and agricultural operations in palm pest control and the number of palm trees for each farmer as independent variables in Karbala Governorate in the study sample as an independent variable, it was shown from Table 6. the statistical significance was proven at the level of 1% for the estimated regression relationship, the production costs of the low application level reached (177897 dinars/ donum), and this was achieved for about 30.5% of the sample farmers, and the average application level, the production costs per donum amounted to about 122109 dinars/

donum, and it was found that about 60.16% of the sample farmers fall into this category, while the production costs amounted to about 171362 dinars/ donum for the category with high application, which represents about 9.34% of the sample farmers. Thus, the positive impact of integrated control using alternatives to chemical pesticides and agricultural operations in palm pest control is evident on the total costs of the study sample, where the average application was the lowest in the total costs and then followed by the high level of application, while the low level of application was the highest in the total costs. This may be due to the farmer's lack of control over the spread of pests in the orchard, which makes him overuse pesticides, which greatly affects costs and the amount of production.

Net profit - application relationship

By estimating the regressive relationship between the net profit per donum as a dependent variable, and the level of application of integrated management using agricultural operations and alternatives to chemical pesticides in the control of palm pests for each farmer as an independent variable in the research sample, it was shown from Table 6, the statistical significance was proven at the level of 1% for the estimated regression relationship, the net profit per donum for the low application level was 61945 dinars/ donum , and this was achieved for about 30.5% of the sample farmers, and the average level of application, the total revenue per donum was 97104 dinars/ donum , and it was found that about 60.16% of the sample farmers fall into this category, while the net profit per donum is about 100599 dinars/ donum for the category with high application, which represents about 9.34% of the sample farmers. Thus, the high positive impact on the total revenue of the application of integrated management using alternatives to chemical pesticides and agricultural operations in the control of palm pests in the study sample is shown, it was found that the high level of application is the highest in terms of net profit, then came in several places at the level of medium application, while the low level of application, which is the lowest in the level of net profit, came in third place.

Conclusions

The results showed that farmers who applied the recommendations of the integrated control program in a high degree achieved a higher level of profit compared to farmers who applied them in a medium or low manner. The results showed that farmers who applied the recommendations of the IPM program at a high or medium level achieved a lower level of costs compared to farmers who applied them lowly. It also showed that farmers who applied the recommendations of the integrated control program in a high or medium manner achieved a higher level of production compared to farmers who applied them lowly. The study recommends increasing support for the integrated pest management program in Karbala Governorate to combat palm pests through financial support for the program and extension programs in this field. It also recommends increasing support for programs related to the use of control methods that rely on the introduction of modern methods of control to reduce costs and protect the environment.

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