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Effect of different concentrations of Indole Butyric Acid on the rooting of Hard-wood cuttings of four cultivars of Bougainvillea sp.

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ABSTRACT
A survey of 60 greenhouse projects covering nearly 3,000 greenhouses was conducted. In the first stage two months before using the land soil samples were taken and analyzed the infestations were classified into three levels (strong infestation, weak infestation, and non-infested) The rate of strong infestations was 15% and weak infestations were 11.7% while the remaining percentage was 73.3% uninfected. In the second stage, samples were taken three months after using the land. The results were 7.6% of these greenhouses were not infected with parasitic nematodes, and the percentage of greenhouses that were weakly infected was 63.4%, but 29% were strongly infected. Most of these greenhouses were sterilised and controlled with highly effective chemical nematicides, and the nematicide Velum Prime was used at a rate of 89%, in a programmed manner in three stages. The cost of the control process per greenhouse ranged between $100-150. 83% of these projects were planted with cucumbers, and the rest ranged between tomatoes and peppers. 1% of these projects moved greenhouses to uncontaminated land.

***Keywords*:** Greenhouses, plant-parasitic nematode, nematicide, Integrated nematode management.

INTRODUCTION

Plant parasitic nematodes are costly burdens of crop production, causing an estimated US$80 – 118 billion per year in damage to crops. They are associated with nearly every important agricultural crop and are a significant constraint on global food security. Regulations on the use of chemical pesticides have resulted in growing interest in alternative methods of nematode control. Future changes in climate, cropping systems, food habits, and social and environmental factors also affect the options for nematode control [1].

As a result of constraints on the use of chemical pesticides, studies on alternative nematode control strategies are becoming more popular due to their complicated interactions with the host plants, vast host range, and degree of harm produced by infection. One of these nonchemical nematode control methods is the identification and use of host resistance. In this summary, nematode interactions are highlighted [2].

Transcriptome profiling studies have recently been used to distinguish between worm resistant and susceptible genotypes as well as to identify the precise molecular components and pathways active during the plant defense response to nematode invasion. This analysis emphasizes the importance of plant-parasitic nematodes in agriculture and the molecular mechanisms underpinning plant-nematode interactions [3].

The effects of pesticides on aquatic systems are studied using a hydrological transport model, which is a mathematical model used to simulate river and stream flow indicators and calculate water quality. These models began to be used in general in the 1960s and 1970s, when environmental legislation began to require the use of forecasting Water Quality Digital), to study the movement and fate of chemicals in rivers and streams. Quantitative analysis of pesticide runoff was conducted in the early 1970s to predict the amounts of pesticides that might reach surface waters. [4].

Root-Not nematodes

The top 10 parasitic worm genera in molecular plant pathology were recently classified according to their significance for science and industry. The root-knot nematodes (*Meloidogyne spp*.) are ranked first. *Meloidogyne javanica*, *Meloidogyne arenaria*, *Meloidogyne hapla,* and *Meloidogyne incognita* are the species of the root-knot nematode (*Meloidogyne spp*.) that pose the greatest harm to agricultural crop output [5].

The larval stage 1 (inside the egg), larval stage 2 (migratory), larval stage juvenile 3 (sedentary), larval stage 4 (sedentary), and adult stage (sedentary) are the four developmental stages that make up the life cycle of Meloidogyne spp. In the presence or absence of a chemical stimulus, first-stage moulting to the J1 larval stage within the egg takes place under favourable environmental circumstances, leading to hatching. Juveniles in the infectious second stage (J2s) are frequently drawn to root exudates and go to the tips of the roots, where they enter beneath the root cap at the elongation zone [6]. By forcing their stylets into plant cells, root knot nematodes weaken them and release Enzymes that break down cell walls are used to separate the middle lamella when intercellular migration through root cortical cells takes place to reach the procambium cells of the vascular cylinder, which are undifferentiated. The activity of the dorsal glands rises in the latter stages of primary infection to encourage the movement of secretory granules to the stylet, where proteinaceous secretions are discharged in the formation of the major feeding site the giant cell. [7], [8]. Chemical nematicides are frequently employed to control root-knot nematodes, but EPA prohibitions on some soil fumigants constrain their accessibility due to increased environmental toxicity and the high costs involved with new nematicide development [9].

These animal insecticides are dangerous to humans by their very nature. Because plant tissue frequently harbours plant-parasitic nematodes, it is difficult to apply the chemical to the soil. A desirable and useful strategy for plant breeders is including plant types that have multiple resistance to various plant diseases. The discovery of more resistant cultivars is becoming increasingly important for long-term control since the continued usage of particular genotypes of disease-resistant cultivars may contribute to enhanced pathogen aggressiveness leading to epiphytotic circumstances [10].

Through phenotypic screens and genetic analysis, crops have been intentionally chosen for many years for their natural disease resistance. Through transgenic techniques like agrobacterium-mediated transformation, nematode-resistant genes discovered in gene pools of various plant species have been introduced into the genomes of commercially significant crops with natural vulnerability [11].

This pest has spread widely in our agricultural areas, as it appeared in vast areas of agricultural projects and has become a dangerous phenomenon that threatens food security because of its destruction of crops, especially in greenhouses due to the density of cultivation in them, and because of the focus on one crop, which is cucumber, especially in the years from 2009 to 2015 and the concentration of farmers And the owners of projects on production only, the indiscriminate use of nematode pesticides had a serious impact on the environment and human health [12].

Integrated Pest and Nematode

The term “integration” has diverse connotations for various groups; the most common themes in the definitions were economy, environment, pest populations, control, strategies and ecology in that order. IPM is described as “a decision support system for the selection and use of pest control tactics singly or harmoniously coordinated into a management strategy based on cost-benefit analyses that consider the interests of and impacts on producers’ society and the environment” [13]. IPM is a crucial component of sustainable agriculture, according to Duncan, and given the following drivers and restrictions, this group of players is more crucial than ever.

Specific crop management strategies, production techniques, and one or more plant parasitic nematodes that are either present alone or concurrently within a cropping system are frequently included in the definition of INM. However, nematode management is dynamic and adapts as new technologies are developed, as external factors such as drivers and limitations effect crop growth, as nematode issues arise, and as grower demands alter in significance. [14]. According to [15] “Integrated pest control is a pest population management system that utilizes all suitable techniques in a compatible manner to reduce pest populations and maintain them at levels below those causing economic injury.” This is how FAO explicitly defined integrated pest management in 1968. By integrating research development technology transfer and implementation to manage one or more nematode species using two or more control strategies [16] created INM.

Managing the soil

Crops may withstand worm damage under ideal growth circumstances as a result good soil management is a key component of INM (integrated nematode management) Basic requirements for a healthy crop which are not universally accepted include nutrient and water management correct tillage and organic matter content A robust plant is more resistant to the effects of pests and diseases [17]

Materials and Methods

Study area

Soil samples were collected from different locations in 60 projects in Bazian plain (Fig. 1) is a significant and large agricultural area that has at least 17,000 greenhouses and is located 20 km southwest of Sulaimaniyah province in Kurdistan region of northeastern Iraq at 35N latitude and 45E longitude. The sea surface level reaches there (837m–847m). Bazian Plain, a broad plain with a small incline, is also part of Basarah Basin, which is situated in a high folded zone, Sulaimaniyah city It may be identified by the way its surface appears in general. It is steep surrounded by little plains and valleys. The city is located at 35°33′26″N and 45°26′08″E, 850 meters above sea level. The city is flanked by many mountain ranges that go from north to south. Sulaimaniyah is situated on 3.5% sloped terrain. The southern end of the city is 800 meters above sea level, while the northern end is 885 meters [18].

Soil Sample Taking for Nematode Analysis

Soil samples were taken from the sites of the study area in order to analyze them for infection with nematodes in the research laboratories of the Plant Protection Department in the Sulaimaniyah Agricultural Research Directorate/ Iraq. Nematode samples were taken from 25-35 cm depth throughout the summer season, cleaned and sanitized the shovel after each use, then the samples were placed in bags for analysis by using the sieving method.

Table. 1. Procedure of nematode analysis.

No.	Materials	Procedure and Source
1	20-mesh sieve (833 µm aperture)	[19
2	200-mesh sieve (74 µm aperture)	
3	325-mesh sieve (43 µm aperture)	
4	Coarse sieve (1 cm aperture)	
5	Two stainless steel bowls or plastic buckets	
6	250 ml beaker, 600 ml beaker	
7	Coarse spray wash bottle or tube attached to faucet	

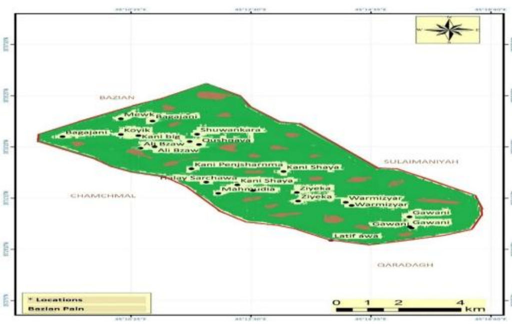

Fig. 1. Location of Study area in Bazian plain, Sulaimaniyah Province, Iraq

Results and Discussion

In this study, a specific area was surveyed in Bazian plain in order to search for Rot-not nematodes, and the results were as shown in the table below

Table. 2. Localities of the soil samples of 60 different sites in Bazian plain, Sulaimaniyah Province, Iraq

L.	GPS Coordinates		Crop sowed season before	Effected or not With Nematodes before plant sow	Effected or not with Nematodes 3 months after planting
	Latitude	Longitude			
L1	35°34’36.5”N	45°10’53.6”E	Cucumber	Not infected	Weak infection*
L2	35°34’35.5”N	45°10’51.1”E	Cucumber	Not infected	Weak infection*
L3	35°34’35.2”N	45°10’46.1”E	Cucumber	infected	Weak infection*
L4	35°34’34.3”N	45°09’54.9”E	Cucumber	infected	Weak infected*
L5	35°34’20.2”N	45°09’47.9”E	Cucumber	Not infected	Not infected
L6	35°34’19.0”N	45°10’31.9”E	Cucumber	Not infected	Not infected
L7	35°34’18.1”N	45°10’30.7”E	Cucumber	infected	Not infected
L8	35°34’17.9”N	45°09’57.1”E	Cucumber	infected	Not infected
L9	35°34’15.5”N	45°09’56.0”E	Cucumber	Not infected	Not infected
L10	35°34’12.6”N	45°10’45.3”E	Cucumber	infected	infected
L11	35°34’10.7”N	45°09’54.1”E	Pepper	infected	infected
L12	35°34’08.0”N	45°09’51.0”E	Tomato	infected	Not infected

L13	35°34’06.0”N	45°09’55.4”E	Cucumber	Not infected	Not infected
L14	35°34’05.9”N	45°09’55.2”E	Cucumber	infected	Not infected
L15	35°34’01.3”N	45°10’04.2”E	Cucumber	infected	Not infected
L16	35°33’54.1”N	45°10’13.7”E	Cucumber	Not infected	Not infected
L17	35°33’40.8”N	45°10’16.3”E	Tomato	Not infected	Not infected
L18	35°33’38.3”N	45°10’33.8”E	Cucumber	infected	Not infected
L19	35°33’36.3”N	45°10’11.8”E	Cucumber	infected	infected
L20	35°33’31.3”N	45°12’06.4”E	Cucumber	infected	Not infected
L21	35°33’30.4”N	45°12’14.7”E	Cucumber	Not infected	Not infected
L22	35°33’29.6”N	45°12’12.9”E	Cucumber	Not infected	Not infected
L23	35°33’24.4”N	45°12’18.5”E	Cucumber	infected	Not infected
L24	35°33’23.0”N	45°11’45.2”E	Cucumber	infected	Not infected
L25	35°33’12.4”N	45°11’21.2”E	Cucumber	infected	Not infected
L26	35°33’09.5”N	45°11’31.7”E	Cucumber	infected	Not infected
L27	35°33’05.7”N	45°11’21.4”E	Cucumber	Not infected	Weak infection*
L28	35°33’01.3”N	45°11’36.5”E	Pepper	Not infected	Weak infection*
L29	35°32’53.5”N	45°11’24.7”E	Tomato	infected	Not infected
L30	35°32’25.6”N	45°11’48.0”E	Cucumber	infected	Not infected
L31	35°32’08.6”N	45°11’55.8”E	Cucumber	infected	Not infected
L32	35°32’03.6”N	45°12’12.6”E	Cucumber	infected	Not infected
L33	35°32’03.4”N	45°12’08.7”E	Cucumber	infected	Not infected
L34	35°31’57.0”N	45°12’01.7”E	Cucumber	Not infected	Weak infection*
L35	35°31’53.4”N	45°11’34.1”E	Cucumber	Not infected	Not infected
L36	35°31’52.9”N	45°12’00.5”E	Cucumber, Pepper	Not infected	Not infected
L37	35°31’52.7”N	45°11’34.1”E	Cucumber	infected	Not infected
L38	35°31’51.6”N	45°12’14.2”E	Tomato, eggplant	infected	Not infected
L39	35°31’45.1”N	45°12’01.0”E	Cucumber	infected	Not infected
L40	35°31’29.8”N	45°12’39.8”E	Cucumber	infected	Not infected
L41	35°31’25.9”N	45°11’56.5”E	Cucumber	infected	infected
L42	35°31’21.0”N	45°12’07.8”E	Pepper, eggplant	Not infected	Not infected
L43	35°31’18.7”N	45°12’12.6”E	Cucumber	Not infected	Not infected
L44	35°31’13.7”N	45°12’08.4”E	Cucumber	Not infected	Not infected
L45	35°31’10.8”N	45°12’18.3”E	Cucumber	infected	Not infected
L46	35°30’55.9”N	45°12’52.4”E	Cucumber	infected	infected
L47	35°30’53.1”N	45°14’22.0”E	Cucumber	infected	Not infected
L48	35°30’43.8”N	45°13’04.1”E	Cucumber	infected	Not infected
L49	35°30’19.3”N	45°14’51.6”E	Cucumber, Tomato	infected	Not infected
L50	35°30’16.8”N	45°15’14.4”E	Cucumber	infected	Not infected
L51	35°30’14.2”N	45°15’18.9”E	Tomato	infected	Not infected
L52	35°30’03.4”N	45°15’15.0”E	Tomato, Pepper	infected	infected
L53	35°29’38.5”N	45°15’31.3”E	Cucumber	Not infected	Not infected
L54	35°29’26.0”N	45°15’42.2”E	Cucumber	Not infected	Not infected
L55	35°29’08.6”N	45°16’02.5”E	Cucumber	Not infected	Not infected
L56	35°29’08.5”N	45°15’51.6”E	Cucumber	infected	Not infected
L57	35°29’03.5”N	45°15’48.4”E	Cucumber	infected	Not infected
L58	35°27’56.7”N	45°14’46.3”E	Cucumber	Not infected	Weak infection*
L59	35°24’44.6”N	45°14’38.3”E	Tomato, Pepper	infected	infected

L60	35°18’33.5”N	45°14’21.2”E	Pepper, eggplant	infected	Weak infection*

* Weak infection, infecting plants in small numbers, relatively affecting production

Table. 3. Percentage ratios for infected and not in study locations

Percentage of plastic greenhouses that were treated with nematodes	Major crops grown		% Of infection with Nematodes two months before planting			% Of infection with nematodes 3 months after planting		
	cucumber	others	Not infected	Weak infection	infected	Not infected	Weak infection	infected
%89	83.3	16.7	73.3	15	11.7	7.6	63.4	29

According to the reality of this study, the majority of greenhouse farmers, amounting to 89%, use nematicides excessively and programmed to treat and control this pest, completely avoiding environmentally friendly methods of control and without referring to the relevant agricultural departments, as the farmer adds the pesticide before planting the seedlings for the first time [20], one month after planting for the second time, and a month later for the third time. From (Table 3) 73.3% of the soil samples taken before planting were not infected, and the reason for this is due to the fact that these samples were controlled with nematode pesticides, while the rates of infected samples were 11.7%, and the rates of weak infections were about 15%. As for the samples taken after planting, they indicate an excessive use of nematode pesticides, as the percentage of infected project soils was about 29%, while the uninfected soils were 7.6%, and the weakly infected soils were 63.7%. Among the investigations conducted during the study period, most project owners use highly dangerous nematicides for human health and the environment. After the rapid spread of greenhouse projects without study and planning after 2010, this pest began to appear and spread rapidly in the Bazian region for the following reasons.

4- Leaving infected roots and plant parts in the soil of the infected plastic house without getting rid of them by removing or burning them.

2- Using infected machines in uninfected soils.

3- Use and transfer infected soil or manure to uninfected places.

4- Pollution of the irrigation water or the equipment used. [21].

[22] In 2017, this pest became an epidemic, spreading in most regions, and the farmers of these regions suffered from this matter. It caused huge financial losses to the plastic house infected with nematodes, which amounted to 500 dollars each, including tillage, seeds, fertilisers and pesticides used, and replanting again (from the researcher’s investigations). Therefore, the owners of these projects had to rely on themselves to take any measure to save what could be saved from their projects. Therefore, chemical nematode pesticides were resorted to in batches before planting and during cultivation, which contributed to controlling this pest temporarily and during cultivation only and within limits. The plant and its root group (from the researches investigations). Negative impact of the use of Nematicide on the environment can be summarized by:

Climate Change and using Nematicide

[23] Understanding how regional warming affects agriculture and how to mitigate its effects as well as how to manage drought conditions depends on the overlap between temperature rise and its effects on agriculture and the types of plants that are cultivated Increasing Sulaimaniyah air temperatures have an impact on plant distribution and production. The ability of vegetables to fight certain illnesses to change due to global warming as well as an increase in disease among living things due to mutation brought on by environmental stress. Climate change is altering pest distribution and may trigger increased pesticide use. At the same time, pesticide pollution reduces natural pest control and encourages organisms to become resistant to pesticides, leading to a vicious cycle of increased pesticide use [24].

How pesticides impact ecosystems

Nematodes in particular and pesticides in general are inherently dangerous to living organisms. Even when they are specifically designed to target a specific pest such as a parasitic nematode, they can have an impact on ecosystems. Individually very high nematode levels have an impact on the environment especially the agricultural environment under study and reduce the diversity of ecosystems so they can still have a detrimental effect on crop areas even if used in lower amounts [25].

Conclusions

Contamination with nematode pesticides causes a loss of biodiversity, which leads to a significant decrease in the number of beneficial insects, which threatens the crucial role they play in food production. 83% of the greenhouses used nematode pesticides, and thus, nematode residues remain in these soils. Excessive use of nematicides in the study area causes concern and requires microbial studies and analyzes to find out the concentrations of pesticide residues.

Based on the investigations of this study and given the seriousness of the current situation and the excessive use of pesticides, there is a need to find alternatives to these pesticides and move towards sustainable agriculture.

One of the results of the investigations of this study is that the agricultural production in most of the projects in the region depends entirely on the use of chemical pesticides. Therefore, there is a need for a government investigation about the quantities of pesticides used in these projects and the quantities of pesticides sold in the local markets, in addition to imposing specific instructions for this type of pesticide. In addition to conducting soil tests for these projects to determine the degree of toxicity.

The continuous change in the climate requires urgent solutions to prevent a rise in temperatures and preserve the cultivation environment, as the weakness of the plant due to its resistance to changes in temperature and the attempt to adapt to these changes leads to the weakness of the plants in the face of pests. Encouraging farmers and farm owners to create and launch calls for national campaigns to raise farmers' awareness towards farming that is free from or reduces chemical pesticides, and to develop strategic plans towards toxic-free agricultural products, non-pollution and biodiversity policy.

Through this study, it was found that the quantities of pesticides used are high, so there is an urgent need to conduct tests for the residues of these pesticides in the human body, especially among children in the study area. Within this review, the current situation was clarified, which shows the size of the infection with nematodes and the quantities of chemical pesticides used in the study area, in addition to some difficulties in managing and dealing with the data of this problem. Therefore, there is an urgent need to hold meetings and courses with the farmers.

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مسح للنيماتودا الطفيلية لدراسة وتقييم أضرارها على القطاع الزراعي في سهل بازيان، محافظة السليمانية / العراق.

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الخلاصة

من دراسة نتائج هذا المسح لمنطقة بازيان ذات الأهمية الزراعية في محافظة السليمانية لأنها تحتوي على ما لا يقل عن 17 ألف بيت بلاستيكي والتي عانت في السنوات السابقة من الإصابة بالديدان الخيطية لدرجة الوباء مما أدى إلى تدهور حاد في المحصول بالإضافة إلى الخسائر المالية ويرجع ذلك إلى المكافحة المستمرة لهذه الديدان الخيطية الطفيلية. وتعتمد الطرق التقليدية لمكافحة هذه الطفيليات على مركبات كيميائية لها تأثير مضاد للطفيليات مثل المبيدات الحشرية المضادة للديدان والتي لها تأثير ضار على البيئة. تم أجراء دراسة استقصائية لـ 60 مشروع بيت بلاستيكي والتي تشمل ما يقرب من 3000 بيت بلاستيكي. في المرحلة الاولى (قبل شهرين) من حراثة الارض أخذت عينات من الترب وتم تحليلها، درجت الاصابات الى ثلاث مستويات (أصابة قوية، أصابة ضعيفة، غير مصابة) كان معدل الإصابات القوية فيها 15% و الضعيفة 11.7٪ بينما كانت النسبة المتبقية 73.3٪ غير مصابة. في عينات المرحلة الثانية التي تم أخذها بعد حراثة الارض (بثلاثة أشهر) كانت النتائج أن 7.6% من هذه البيوت البلاستكية غير مصابة بالنيماتودا الطفيلية وكانت نسبة البيوت البلاستيكية الضعيفة الاصابة 63.4% ولكن 29% كانت مصابة بقوة. تم تعقيم و مكافحة معظم هذه البيوت بمبيدات النيماتودا الكيميائية عالية الفعالية واستخدم المبيد النيماتودي Velum prime بنسبة 89% وبطريقة مبرمجة على ثلاث مراحل، عملية المكافحة هذه تراوحت كلفتها بين 100−150 دولار لكل بيت بلاستيكي. 83% من هذه المشاريع تمت زراعتها بالخيار والباقي تراوحت بين الطماطم والفلفل. 1% من هذه المشاريع قام ملاكها بنقلها إلى أراضٍ غير ملوثة، ولم يستخدم أي منها طرقاً صديقة للبيئة أو على الأقل غير كيميائية لمكافحة الديدان الخيطية. أتضح أن الفلاحين يستخدمون هذه الطريقة المبرمجة في المكافحة منذ عشرة سنوات وهذه المدة كافية لترك أثار سلبية على البيئة البايلوجية للنبات، لا توجد أية قيود قانونية على الفلاحين في أستخدام هذه المبيدات.

الكلمات المفتاحية : الدفيئة المحمية، نيماتودا، المبيدات النيماتودية، الادارة المتكاملة لمكافحة النيماتودا.