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Effect of Some Plant Extracts and Bio-Control on Snap Bean Root Rot Infection, Growth, Green Yield and Pods Quality During Autumn Seasons

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Abstract: Snap bean is considering one of the most important exportation vegetable crops in Egypt for exportation. Green pods of snap bean are an essential source of protein for vegetarian diet, but it infect by one of the serious fungus diseases i. e., root- rot disease especially at late spring and autumn seasons. So, two field experiments were carried out during two autumn successive seasons of 2018 and 2019 years at the Experimental Farm of Kaha Station, Qalubia Governorate, Egypt to evaluate two methods of adding some plant extracts and bio-control i. e., dipping the seeds before sowing and dipping the seeds before sowing with drenching the plants three times during growing season by some plant extracts i. e., Ginger, Thyme, Rosemary and Clove as well as some bio-control (Tricohdrema 34 or Biochare) treatments compared with pesticides "Tebuconazole" on reducing the influence of root rot disease and minimizing its injury as well as reflect of that on growth and yield of snap bean (*Phaseolus vulgaris* L) cv. paulista. The results showed that dipping the seeds before sowing by 30 minutes and drenching the plants three times during growing by plant extracts of ginger, rosemary, thyme and biochare have led to decrease root rot disease severity (%) in both seasons compared with fungicide "Tebuconazole" and the control. Additionally, the plant extracts have an effective role in decreasing the cell wall-degrading enzymes (viz. cellulose and polygalactonase) secreted by fungi causing root rot diseases. i.e., the snap bean plants treated with thyme, ginger and rosemary in both the two methods of adding which have a lowest cellulose and polygalacturonases enzyme content. On the other hand, these plant extracts led to the highest value of total phenols in snap bean plants. In the other side, the results clear that, dipping the seeds before sowing and drenching the plants three times during growing by Ginger, Thyme, Rosemary and Clove as well as bio-control (Tricohdrema 34 or biochare) induced a significant effect on the vegetative growth parameters of snap bean plants and registered higher green pods yield and best pods quality than the control. According to the obtained results, it can recommend to dipping the snap bean seeds before sowing (30 minutes) with drenching the plants three times during growing by any one of the previous plant extracts i.e., Ginger, Thyme, Rosemary or Clove as well as Tricohdrema 34 or biochare) respectively, to obtain high yield and lowest infection.

Key words: Snap bean (*Phaseolus vulgaris* L) · Root rot disease · Biochare · Tricohdrema 34 · Plant extracts · Ginger · Thyme · Rosemary · Clove · Vegetative growth · Yield

INTRODUCTION

Snap bean (*Phaseolus vulgaris* L.) is one of the most important vegetable crops grown in Egypt for both local consumption and exportation. It is very rich in protein content which is essential for human nutrition rather than the role of such crops in improving soil fertility [1]. Root- rot diseases affect the yield qualitatively and quantitatively especially in the heavy soils [2]. The main pathogens responsible for damping- off and wilt incidence on bean are *Rhizoctonia solani* and *Fusarium oxysporum f. sp. Phaseoli.*, respectively [3].

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Biological control is proposed to be an effective and non-hazardous strategy to reduce crop damage caused by plant pathogens. The soil borne pathogens viz., fungi, actinomycetes, bacteria and nematodes play a major role in the development of root rot and root knot disease complex of crop plants. The soil borne disease causing pathogens are difficult to eliminate since they produce resting structure like sclerotia, chlamydospores which are well adapted to survive for longer periods under adverse environmental conditions. These pathogens infect roots of the plants, limiting nutrient uptake by plants and produce root rot disease complex resulting in death of the plant [4].

Paula *et al.* [5] indicted that, *Trichoderma harzianum* protected the bean seedlings against pre-emergence damping off infection, reduced the disease severity and increased the plant growth in the presence of *R. solani* pathogen. However, El-Mohamedy and Abd-Alla [6] noted that practical using of bio-priming seed treatment to control root rot soil borne plant pathogens as a substitute of chemical fungicides is possible without any risk to human, animal and the environment. Moreover, application of biological control using antagonistic microorganisms against seed and root rot pathogens proved to be successfully and its efficiency in controlling root rot pathogens and improving plant growth, total yield and nutritional values of many vegetable crops [7]. Also, they found that soaking green bean seeds in chemical inducers and coated with biocontrol agent *T. harzianum*in dividedly or in combination treatments significantly reduced root rot diseases and increased survival green bean plants under either green house or field conditions. In addition, these treatments increased plant growth, yield quantity and quality [8].

1. Kookana [9] shows from its reviews the role of biochar in modifying the environmental fate, bioavailability and efficacy of pesticides in soils. The author highlights the lack of research in this area; however, limited research suggests that biochar can reduce the bioavailability and efficacy of pesticides in soils. Biochare has been shown to inhibit the microbial degradation of pesticides and thus can influence the potential accumulation and ecotoxicological impact of pesticides in soil.

Use of botanicals instead of chemical fungicides is one of the recent approaches for plant disease control, as fungicides may cause health hazard and may directly increase environmental pollution. However, some research works has been found in controlling wide range of seed borne pathogens by different botanicals [10, 11].

The demand for essential oils from medicinal plants has increased in recent years, especially in the case of oil from rosemary. Rosemary contains a number of important compounds such as 1, 8- cineole (27.23%), α- pinene (19.43%), camphor (14.26%), camphene (11.52%) and β-pinene (6.71%) [12]. Also, It has aromatic and medicinal species (for example *Rosmarinus officinalis* L.) with antimicrobial and antioxidant activities [13, 14]. This plant has a high availability and low cost.

Islam *et al.* [15] reported that garlic, ginger and neem extract showed statistically similar effect as of seed treatment with vitavax-200 against *Bipolaris sorokiniana.* Also, Suleiman and Emua [16] evaluated some plant extracts against *Pythium aphanidermatum* (damping-off causing pathogen) and found ginger rhizome extract reduced 70% infection of *Pythium aphanidermatum* on cowpea *in vivo*.

Thymus (thyme) belongs to the Lamiaceae family. Essential oil of thymus T_{EO} contains more than 60 components, most of which possess important beneficial effects; for example, antiseptic, carminative, antioxidant and antimicrobial properties. The most important compounds of T_{EO} are the phenols thymol (68.1%) and carvacrol (3.5%), which constitutes the major and most active constituents, as well as the monoterpene hydrocarbons p-cymene (11.2%) and -terpinene (4.8%), which are known to have antioxidant properties and antimicrobial activity. The antibacterial properties of these compounds are, in part, associated with their lipophilic character, leading to their accumulation in membranes and to subsequent membrane-associated events, such as energy depletion [17]. On the other hand, Solomakos *et al.* [12] reported that, thyme contains a number of critical compounds such as the phenols: thymol (44–60%) and carvacrol (2.2–4.2%). (Poly) phenolic compounds are characterized by having redox properties, which allow them to act as reducing agents, hydrogen donors, singlet oxygen quenchers and metal chelators. Several researchers have carried out assessments of antioxidant activity based on the DPPH assay in different Thymus species. These studies showed that the chemical structure of the phenolic compounds of T_{EOs} allows them to donate hydrogen to free radicals and explains their antioxidant activity [18].

Several reports have documented the antibacterial, antiviral, anticarcinogenic and antifungal activities of some aromatic herbs including cinnamon, oregano, clove, thyme and mint. However, clove has gained much attention among other spices due to its potent antimicrobial and antioxidant activities [19]. Also, Hu and

willett [20] reported that the effective role of clove in the inhibition of different degenerative diseases is attributed to the presence of various chemical constituents in high concentrations with antioxidant activity.

This study was aimed to: evaluate two methods of adding some plant extracts i. e., Ginger, Thyme, Rosemary and Clove as well as some bio-control (Tricohdrema 34 or biochare) treatments compared with pesticides "Tebuconazole" on reducing the influence of root rot disease and minimizing its injury on vegetative growth, productivity and pod quality of snap bean grown in clay soil during autumn season.

MATERIALS AND METHODS

Two field experiments were carried out during two successive autumn seasons of 2018 and 2019 at the Experimental Farm, Kaha Station, Qalubia Governorate, Egypt to evaluate the effect of some plant extracts and bio-control treatments compared with pesticides on reducing and minimizing the injury of root rot disease and reflect of that on growth and yield of snap bean plants (*Phaseolus vulgaris* L). Soil of the experiment was clay in texture with 7.2 pH, 3.5 EC 1.15% organic matters, 115 ppm N, 41 ppm P and 99 ppm K.

Seeds of snap bean cv. Paulista were obtained from Horti. Res. Inst., Agri. Res. Cen. (ARC), Egypt and sown on 15th and 19th September in 2018 and 2019, respectively in hills on one side of ridges at 7 cm spaces. The area of each experimental plot was 7.2m^2 includes 3 ridges each of 4m length with 0.6 widths. Other agricultural practices required for snap bean production were carried out as commonly followed in the district.

The experiment was arranged in a split plot design with three replicates. It was include sixteen treatments which were combinations between two methods of adding and eight materials used, as shown in Table (1).

Plant extracts were prepared by dissolve 200gm of each plant leaves i.e., Ginger, Thyme, Rosemary and Clove in water for 12 hours, after that filtered the solution to obtain 100% concentration of each one.

Dipping seeds of snap bean before sowing in plant extracts by 30 minute. While, treating snap bean seeds were dressed with pesticide "Tebuconazole" at the recommended dose (3 g/kg seeds) and biochare at rate of 20 g/ Kg seeds. While, drenching the plants were doing three times with plant extracts i. e., Ginger, Thyme, Rosemary and Clove at rate of 5ml / L, as well as biochare solution 4% and pesticides solution 1 g / L during growing season whereas the first time was at 21 days after sown and repeated each 10 days interval.

Table 1: Names of the treatments used in this study and methods of adding materials

Main plots	Sub plots
The methods of adding materials	The materials used
1-Dipping seeds before sowing.	1-Water (control)
2-Dipping seeds before sowing by	2-Ginger plant extract
30 minutes and drenching the plants	3-Thyme plant extract
three times during growing season.	4-Rosemary plant extract
	5-Clove plants extract
	6-Recommended pesticides "Tebuconazole"
	7-Bio- pesticides "Tricohdrema 34"
	8-Biochare and biochare solution

Data Recorded:

Disease Severity Assessments: Root-rot infections were recorded after 60 days from sowing on a scale of 0-5 as described by Emara [21] as the following:

0 = No symptoms (apparently healthy), 1= Slight browning of roots, but no symptoms in the top, 2 = Browning of the root, with slight chlorosis of the leaves, 3 = Browning of the roots, with medium chlorosis of the leaves, 4 = Browning of the root system, with strong chlorosis of the leaves, 5 = Necrosis and root system completely rotted and plant death.

Then calculated as formula:

$$\% \text{ of root rot} = (0 \times n0) + (1 \times n1) + (2 \times n2) + (3 \times n3) + (4 \times n4) + (5 \times n5) / \text{Total No. of plants} \times 5$$

where, n = number of the diseased plants in each scale.

Relationship Between the Infection and Some Enzymes in Snap Bean Plants

Extraction and Estimation of Phenolics: The total phenolic content (µg catechol/g tissue) was analyzed spectrophotometrically using the Folin-Ciocalteu colorimetric method described by Singleton *et al.* [22].

Determination of Polygalacturonases Enzyme Activity: Polygalacturonase enzyme activity was quantified by measuring the absorbance at 575 nm caused by the release of reducing sugars from citrus pectin by using method described by Miller [23].

Cellulase (Cx) Enzyme Activity: Cellulase (Cx) activity was assayed by the viscosimetric method of Hancock *et al.* [24]. The results were expressed as the per cent loss in viscosity in 15 min. V= T0 –T1/T0 – Tw, where V per cent loss in viscosity, T0 – flow time in seconds at zero time, T1 flow time of the reaction mixture T1 and Tw – flow time of distilled water.

Vegetative Growth Parameters: Five plants were randomly taken from every treatment in the three replicates at flowering stage (at 60 days after seeds sowing) in order to determine the following: Plant length (cm), stem diameter (cm), number of branches/plant, number of leaves/plant, total dry weight of plant (g), leaf area.

The leaf area was calculated according to the following formula of Wallace and Munger [25].

$$\text{Leaf area } (cm^2) = \frac{\text{Leaves dry weight (gm)xdisk area}(cm^2)}{\text{Disk dry weight(gm)}}$$

Yield and its Components

Green Pods Yield and its Characteristics: At harvest green pods (at 70 – 75 days after seeds sowing) in the second pickings a random sample of 10 fresh green pods from each plot were taken to determine the following data: Average pod length (cm), Average pod diameter (cm), Average pod weight (g).

Total Green Pods Yield: At harvest stage the mature pods of snap bean for each experimental plot were collected along the harvesting season, the total pods yield was recorded as ton/fed.

Chemical Components: The following measurements were determined:

Total leaf chlorophyll was measured using Minolta chlorophyll Meter SPAD- 501 as SPAD units.

N, P, K and total protein: Green pods at the edible stage of snap bean were dried in an electric forced-air oven at 70°C to constant weight then fractionated and sifting. The fine powder (at 0.2g) of dry sample was digested in a mixture of sulphuric and perchloric acids according to Piper [26]. Total protein in pods was calculated by multiplying nitrogen in 6.25 as described by Stewart [27]. N (%) was determined by using microkjeldahl, while P (%) by using calorimetrically and K (%) by using flame photometer according to the methods described by Bremner and Mulvaney [28]; Olsen and Sommers [29] and Jackson [30] for N, P and K, respectively.

Statistical Analysis: All data were subjected to statistical analysis according to the procedures reported by Snedecor and Cochran [31] using M. stat program and the means were compared by L.S.D multiple range tests at the 5 % level of probability in the two seasons of experimentation at the date of the two experiments.

RESULTS AND DISCUSSION

Disease Severity of Snap Bean Plants

Effect of the Methods on Adding the Materials: Present data in Table (2) show that statistical analysis ($p< 0.05$) revealed that the change in using the methods of adding the material some plant extracts i.e., Ginger, Thyme, Rosemary and Clove, bio-pesticide (Trichoderma T34), Tebuconazole fungicide and control were insignificant on the disease severity of snap bean plants in both seasons. It worth to mention that disease severity in season 2019 was 45% in both adding methods, while it was more than 72% in previous season.

Effect of the Materials Used: Data In Table (2) shown that, using some plant extracts (i.e. ginger, rosemary, thyme and biochare) have an effective role in decreasing root rot infection % compared with chemical pesticide (i.e. Tebuconazole) and bio-pesticide (Trichoderma) without significant differences in both seasons. The highest percentage of disease severity were obtained by application of clove and control treatments. These finidings are harmony with Thabet and Khalifa [32] who stated that clove oil described to have useful antimicrobial effects on different types of plant pathogens such as fungi, bacteria and several soil-borne fungi. Moreover, clove could destroy cell walls and membranes of microorganisms and permeate the cytoplasmic membranes or enter the cells, then inhibit the normal synthesis of DNA and proteins [33].

Effect of the Interaction Between the Methods of Adding the Materials and the Material Used: The results of the interaction effect between the methods of adding the materials and materials used induced significantly reduction diseases severity (%) of root rot disease compared to the untreated control. Moreover, the application tested plants extracts have an effective role in decreasing disease severity compared with check treatment. *i.e.*, ginger extracts have an actual role in decreasing the disease severity. i.e. the disease severity were 69.3 and 73.3% in 2018 season by application dipping seed alone and with plant drenching, respectively. Whereas it was 35, 50.30 % in by application the both methods in 2019 season. Similar results by Nguanpuag *et al.* [34] and Yashoda [35] who reported that extracts of ginger had antimicrobial activity against fungi by both methods possessed antimicrobial activities against *Fusarium* sp. Also, ginger possesses a noticeable antimicrobial activity which was confirmed by checking the susceptibility of different strains of bacteria and fungus by measuring the zone of inhibition [36].

Table 2: Effect of the methods on adding some plant extracts as well as bio-control treatments and their interaction between them on disease severity of snap bean plants infected by root rot disease after 60 days from sowing in both 2018 and 2019 growing seasons

		Disease severity (%)	
Treatments		2018	2019
	The methods of adding the materials		
Dipping seeds		72.56	45.60
Dipping seeds and drenching		74.17	45.56
LSD at 5%		NS	NS
	Materials used		
Ginger extract		71.30	42.65
Thyme extract		70.65	41.65
Rosemary extract		73.00	33.30
Clove extract		75.75	50.00
Tebuconazole		73.00	33.80
Trichodrema 34		71.30	53.30
Biochare		66.65	44.95
Water (control)		85.30	65.00
LSD at 5%		5.08	6.44
	The interaction between the factors		
Dipping seeds	Ginger	69.30	35.00
	Thyme	73.30	58.30
	Rosemary	70.00	28.30
	Clove	74.00	45.00
	Tebuconazole	78.00	43.30
	Trichoderma	69.30	51.60
	Biochare	61.30	38.30
	Control	85.30	65.00
Dipping seeds and drenching	Ginger	73.30	50.30
	Thyme	68.00	25.00
	Rosemary	76.00	38.30
	Clove	77.50	55.00
	Tebuconazole	68.00	24.30
	Trichoderma	73.30	55.00
	Biochare	72.00	51.60
	Control	85.30	65.00
LSD at 5%		7.81	4.56

As well as, thyme extract has a good role in declining the disease severity. i.e. the disease severity were 73.3 and 68% in 2018 season by application dipping seed alone and with plant drenching, respectively. Whereas, it was 58.3 and 25 % in by application the both methods in 2019 season. The antifungal activity of thyme essential oils had previously reported on several fungi, including *R. solani* and *M. phaseolina* [37, 38]. Also, According to GC analysis, Thymus contains carvacrol that researchers pointed to its anti-microbial property and inhibition activity of the existence of these two compounds [39]. Beside, rosemary extract has an effective role in declining the disease severity in second season. i.e. the disease severity were 70 and 76 % in 2018 season by application dipping seed alone and with plant drenching, respectively. Whereas, it was 28.3 and 38.3 % in by application the both methods in 2019 season. These results are agree with Bozin *et al.*[40] who documented the antimicrobial activities of essential oils of rosemary and sage against 13 bacterial strains and 6 fungi by the micro-dilution technique.

On the other hand, application the bio-pesticide has a moderate role in decreasing the disease severity of snap bean rot in both seasons. Similar findings are reported by Akrami [41] who showed that *Trichoderma* spp. significantly reduced the incidence of *Fusarium wilt*.

Relationship Between the Infection and Some Enzymes in Snap Bean Plants

Assessment of Phenolic Compounds in Snap Bean Plants

Effect of the Methods on Adding the Materials Used: The data in Table (3) show that the statistical analysis at ($p< 0.05$) revealed that the change in adding methods of some plant extracts i. e., Ginger, Thyme, Rosemary and Clove as well as Tebuconazole fungicide, bio-pesticide and control were significant on the total phenols (%) in snap bean plants reach to 2.11% and 2.4% and this due to application dipping seed alone and with plant drenching respectively. Also, Total phenol accumulations in the host plant induced by applying chemical inducers play an important role in resistance and defense against root rot fungi [42].

Effect of the Materials Used: Data in Table (3) showed that adding the plant extracts. i.e. thyme, ginger, rosemary and biochare and bio-pesticide (Trichoderma T34) led to increasing the activity of the total phenols content compared with chemical pesticide (i.e. Tebuconazole) and the control with significant differences. The estimation on the phenols of snap bean tissues which treated with tested treatments showed that lowest concentration in plants treated with water (control) and the pesticide (Tebuconazole) in both dipping and dipping with drenching methods. While, the highest concentration of total phenols in plants treated with bio-pesticide and plant extracts. Our results confirm the results of other researchers who analyzed the concentration of phenols in different plant parts and measured their values in the leaves [43, 44].

Effect of the Interaction Between the Methods of Adding the Materials and the Materials Used: The results of the interaction effect between the methods of adding the materials and the materials used induced significantly on

Table 3: Effect of the methods of adding and some plant extracts and bio-control treatments as well as their interaction between them on assessment of phenolic compounds in snap bean plants 2018 season

Treatments		Phenolic compounds (µg/g f.w) Free	Conjugated	Total
		The methods of adding the materials		
Dipping seeds		1.51	0.60	2.11
Dipping seeds and drenching		1.58	0.86	2.40
LSD at 5%		0.15	0.08	0.17
		Materials used		
Ginger extract		1.64	0.87	2.51
Thyme extract		2.42	0.67	3.08
Rosemary extract		1.92	0.54	2.46
Clove extract		0.99	1.16	2.15
Tebuconazole		1.25	0.77	2.02
Trichoderma T34		1.92	0.41	2.33
Biochare		1.35	0.74	2.09
Water (control)		0.875	0.55	1.15
LSD at 5%		0.30	0.18	0.34
		The interaction between the factors		
Dipping seeds	Ginger	1.61	0.89	2.50
	Thyme	1.95	0.49	2.44
	Rosemary	2.36	0.03	2.39
	Clove	0.85	1.39	2.24
	Tebuconazole	0.94	1.08	2.02
	Trichoderma	1.65	0.14	1.79
	Biochare	1.45	0.32	1.77
	Control	1.30	0.45	1.75
Dipping seeds and drenching	Ginger	1.67	0.85	2.52
	Thyme	2.19	0.84	3.72
	Rosemary	1.48	1.05	2.53
	Clove	1.13	0.93	2.06
	Tebuconazole	1.56	0.46	2.02
	Trichoderma	2.19	0.68	2.87
	Biochare	1.25	1.15	2.40
	Control	0.45	0.65	1.10
LSD at 5%		0.42	0.25	0.48

the induction phenols in treated plants compared to the untreated control as shown in Table (3). Besides, the application of tested plant extracts have been induced and accumulated free and conjugated phenols in snap bean plants. In other words, snap bean plants treated with thyme, rosemary, ginger and clove in both dipping and drenching and dipping methods only which have a highest free and conjugated enzyme contents. In addition to, the bio-pesticide have high effect on phenols content in the snap bean plants being 2.87% for using dipping and drenching of plants. Whereas, it was 1.79% using dipping snap bean plants only. On the other hand, the lowest phenols content was detected in the plants treated with biochare, selected pesticide (tebuconazole) and untreated control. These changes are possibly responsible for suppression of the pathogen activity in the host and soil. In addition to, accumulation of phenolic compounds at the infection sites showed a correlation with the restriction of pathogen development, since such compounds are toxic substances to pathogens [45]. Also, the resistance may be increased by change of pH of plant cell cytoplasm, due to the increase in phenolic acid content, resulting in inhibition of pathogen development [46].

Enzyme Polygalacturonase Activity

Effect of the Methods on Adding the Materials: The data in Table (4) show that statistical analysis ($p< 0.05$) revealed that the change in the methods of adding the materials of some plant extracts and bio-control were not significant on the estimation of polygalacturonase activity (%) in snap bean plants which it was 37.32% and 38.58% and this due to dipping the seeds alone and with plant drenching, respectively.

Table 4: Effect of the methods of adding and using some plant extracts and bio-control treatments as well as their interaction between them on enzyme Polygalacturonase activity (%) in snap bean plants during two seasons of 2018 and 2019

Treatments		Enzyme Polygalacturonase activity (%)		
		PG0	PG1	PG (%)
		The methods of adding the materials		
Dipping seeds		1.292	0.764	37.32
Dipping seeds and drenching		1.304	0.729	38.58
LSD at 5%		0.20	N.S	N.S
		Materials used		
Ginger extract		0.944	0.707	24.42
Thyme extract		1.218	0.776	32.32
Rosemary extract		1.061	0.749	24.66
Clove extract		1.327	0.814	38.46
Tebuconazole		1.486	0.740	49.65
Trichoderma T34		0.843	0.597	31.34
Biochare		1.347	0.786	41.24
Water (control)		2.160	0.804	61.47
LSD at 5%		0.410	0.107	12.59
		The interaction between the factors		
Dipping seeds	Ginger	0.900	0.760	15.00
	Thyme	1.540	0.833	45.82
	Rosemary	0.892	0.711	18.62
	Clove	1.400	0.820	41.33
	Tebuconazole	1.338	0.680	49.22
	Trichoderma	0.833	0.580	30.36
	Biochare	1.554	0.880	43.36
	Control	1.880	0.848	54.83
Dipping seeds and drenching	Ginger	0.987	0.653	33.84
	Thyme	0.895	0.720	18.83
	Rosemary	1.230	0.787	30.70
	Clove	1.253	0.807	35.59
	Tebuconazole	1.635	0.800	50.08
	Trichoderma	0.853	0.613	32.33
	Biochare	1.140	0.693	39.13
	Control	2.440	0.760	68.11
LSD at 5%		0.580	0.152	17.81

Effect of the Materials Used: Data In Table (4) shows that application of the tested plant extracts i.e., ginger, rosemary, thyme and biochare and bio-pesticide (Trichoderma T34) have an effective role in decreasing the activity of the estimated enzyme compared with chemical pesticide (i.e. Tebuconazole) and the control with significant differences. The estimation on the enzymes of snap bean tissues which treated with tested treatments showed that highest concentration in plants treated with water (control) and the pesticide whereas the estimation refer to lowest units of enzyme in plants treated with bio-pesticide and plant extracts.

Effect of the Interaction Between the Methods of Adding the Materials and Materials Used: The results of the interaction effect between the methods of adding the materials and the materials used induced significantly effect on the enzyme estimation compared to the untreated control as shown in Table (4). Moreover, using the plant extracts have been significant influence on the Polygalacturonase percentage. The plants treated with ginger, rosemary, thyme have lowest enzyme content. Being 15, 18.62, 18.83% respectively, comparing with the control which were 54.83% using dipping and 68.11% using dipping and drenching methods. In addition to, the bio-pesticide has a moderate effect on enzyme content in the snap bean plants being 30.36% when using dipping seeds. While, it was 32.33% by using dipping seeds and drenching methods. On the other hand, the highest PG content was detected in the plants treated with clove, biochare and selected pesticide.

Table 5: Effect of the methods of adding and some plant extracts and bio-control treatments as well as their interaction between them on Cellulose enzyme activity (%) in snap bean plants in 2018 season

Treatments		Cellulose enzyme activity (%)		
		CX1	CX2	CX (%)
		The methods of adding the materials		
Dipping seeds		0.415	0.329	40.06
Dipping seeds and drenching		0.405	0.331	38.74
LSD at 5%		N.S.	N.S.	N.S.
		Materials used		
Ginger extract		0.442	0.371	29.52
Thyme extract		0.379	0.337	23.26
Rosemary extract		0.433	0.353	34.32
Clove extract		0.418	0.328	41.20
Tebuconazole		0.400	0.307	51.76
Trichoderma T34		0.424	0.335	32.66
Biochare		0.403	0.338	40.16
Water (control)		0.384	0.270	62.31
LSD at 5%		N.S.	0.044	7.251
		The interaction between the factors		
Dipping seeds	Ginger	0.4500	0.367	33.33
	Thyme	0.383	0.337	25.40
	Rosemary	0.427	0.347	35.30
	Clove	0.450	0.347	41.32
	Tebuconazole	0.427	0.323	55.44
	Trichoderma	0.408	0.310	32.00
	Biochare	0.377	0.313	41.08
	Control	0.400	0.287	56.60
Dipping seeds and drenching	Ginger	0.433	0.373	25.72
	Thyme	0.373	0.337	21.12
	Rosemary	0.440	0.360	33.33
	Clove	0.387	0.310	41.08
	Tebuconazole	0.373	0.290	48.07
	Trichoderma	0.440	0.360	33.33
	Biochare	0.429	0.363	39.25
	Control	0.3670	0.253	68.03
LSD at 5%	N.S		0.062	10.25

Polygalacturonases and xylanases are very important in pathogenesis, because the degradation of polygalacturonic acid and xylan is performed in early stages of infection. Chen *et al.* [47] reported that Polygalacturonase is a principal enzyme of many fungal pathogens of plants. Previous studies have determined the important role of the PGs by molecular methods. Our results showed that the extracts of ginger, rosemary, thyme and biochare were capable of reducing the activity of PG enzymes. It is clear that the inhibitory effect of plant extract against enzyme activity differed with the time, especially the PG enzymes required for pathogenicity [48]. Also, Abd El-Khair and El-Gamal Nadia [49] mentioned that the essential oils of Chilli, Lantana, Lemon grass and Onion plants differed in their capability for reducing the activity of cell wall degrading enzymes secreted by *R. solani* and *M. phaseolina*, which inhibited their ability to make infection to snap bean plants.

Cellulose Enzyme Activity

Effect the Methods on Adding the Materials Used: The data in Table (5) show that statistical analysis ($p< 0.05$) revealed that the change in adding methods of some plant extracts, Tebuconazole, bio-pesticides and control were not significant on the cellulose enzyme activity (%) in snap bean plants. Being 40.06% and 38.47% due to application dipping seed alone and with plant drenching, respectively.

Effect of the Materials Used: Data in Table (5) clear that application of the tested plant extracts. i.e. thyme, ginger, rosemary and biochare and bio-pesticide (Trichoderma - 34) have led to declining the activity of the estimated enzyme compared with chemical pesticide (i.e. Tebuconazole) and the control with significant differences. The estimation on the cellulose enzyme of snap bean tissues which treated with tested treatments

showed that highest concentration in plants treated with water (control) and the pesticide (Tebuconazole). While, the estimation show to lowest amount of enzyme in plants treated with bio-pesticide and plant extracts.

Effect of the Interaction Between the Methods of Adding the Materials and the Materials Used: The results of the interaction effect between the methods of adding the materials and materials used induced significantly effect on the cellulase enzyme estimation compared to the untreated control as shown in Table (5). Furthermore, the tested plant extracts have been affected on the cellulose enzyme activity. In other words, snap bean plants treated with thyme, ginger and rosemary in both dipping and drenching and dipping adding methods have a lowest enzyme content. Which recorded 21.12, 25.40, 25.72, 33.33, 33.33, 35.30% respectively, comparison with the control which were 56.60% using dipping and 68.03% using dipping and drenching methods. In addition to, the bio-pesticide has a reasonable effect on enzyme content in the snap bean plants being 32% using dipping. While, it was 33.33% using dipping and drenching methods. On the other hand, the highest CX content was detected in the plants treated with clove, biochare and selected pesticide (tebuconazole). It can be concluded that the tested plant extracts have an effective role in decreasing the activity of Cx enzymes which affect of capability of pathogenic fungi to invade plants. These findings are in agreement with results that say the plant extracts may affect the mycelial growth of fungi fungistatic and/or fungicidal [50]. Also, Abd El-Khair and El-Gamal Nadia [49] revealed that the oils of Chilli, Lantana, Lemon grass and Onion plants differed in their capability for reducing the activity of Cx secreted by *R. solani* and *M. phaseolina*, which inhibited their ability to make infection to Snap bean plants.

Our results are corresponding with that stated by Abd-El-Khair *et al.* [38]. Treatments with *Trichoderma* spp. gave the highly protection on bean seedlings against damping off disease at post-emergences stage comparison with per-emergence one. It is may be related to the ability of *Trichoderma* spp. to stimulate the enzymes in bean plants associated with increased the protection against disease. In addition our study revealed that the three four plant extracts were capable of decreasing cellulase activity. Similarly, a previous report indicated that aqueous extracts of Mint, Black cumin and Thyme plants reduced mycelial growth of *R. solani* and *Macrophomina phaseolina*, together with significant inhibition of polygalacturonase and cellulose activities of these fungi in Snap bean plants [46].

Vegetative Growth of Snap Bean Plants

Effect of the Methods on Adding the Materials: Data in Table (6) show that statistical analysis at ($p< 0.05$) revealed that the change in the methods of adding of some plant extracts and bio-control has a significant effect on the vegetative growth parameters of snap bean plants i.e., plant length, number of leaves/plant, number of branches/plant and leaf area. Meanwhile, stem diameter and plant dry weight did not reach to significant level. Whereas, dipping seed before sowing and drenching plants three times during growing season recorded the highest values for all vegetative growth parameters in both growing season.

Effect of the Materials Used: It is shown in Table (6) that, using some plant extracts i. e., Ginger, Thyme, Rosemary and Clove as well as bio-control (Tricohdrema 34 or Biochare) and pesticides treatments led to significant increasing on all vegetative growth parameters of snap bean compared with the control treatment. These results may be due to plant extracts contains many numbers of important compounds and antioxidant compounds, the most active being phenolic diterpenes, such as carnosic acid, carnosol, rosmanol, epirosmanol, isorosmanol, methylcarnosate and rosmarinic acid phenols, antiseptic, carminative and antimicrobial properties as mentioned by Solomakos *et al.* [12]; Satyal *et al.* [13] and Sirocchi *et al.* [14]. These results are in the same line with Paula *et al*. [5] and El-Mohamedy *et al*. [8] on green bean which indicted that, *Trichoderma harzianum* on bean increased the plant growth. Also, El-Mohamedy and Abd-Alla [6] on green bean and El-Mohamedy *et al*. [7] on tomato which reported that, application of biological control using antagonistic microorganisms against seed and root rot pathogens improving plant growth.

Effect of the Interaction Between the Methods of Adding the Materials and the Materials Used: The results of the interaction effect between the methods of adding the materials and materials used induced significant effect on all vegetative growth, i.e., plant length , number of leaves, number of branches, stem diameter and leaf area of snap bean plant, expect dry weight as shown in Table (6). The superior values of vegetative growth were observed from the combination of dipping seeds before sowing and drenching the plants three times during growing season with plant extracts i.e., Ginger, Thyme, Rosemary and Clove as well as bio-control treatments. These results were true in both growing seasons.

Table 6: Effect of the methods of adding and using some plant extracts and bio-control treatments as well as their interaction between them on vegetative growth of snap bean plants during two seasons of 2018 and 2019

		Plant length (cm)		No. of .leaves/ Plant		No. of. brunches/ plant		Stem diameter (cm)		Dry weight g/plant))		Leaf area (cm^2)	
Treatments		2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
The methods of adding the materials													
Dipping seeds		28.08	26.60	12.80	15.14	5.82	5.37	0.63	0.54	6.45	6.91	216.05	225.57
Dipping seeds and drenching		28.79	27.57	13.53	15.68	6.13	5.96	0.64	0.56	6.95	7.09	232.43	240.00
LSD at 5%		0.55	0.87	0.48	.032	0.11	0.10	NS	NS	NS	NS	1.58	8.06
Materials used													
Ginger extract		27.25	25.73	12.67	16.22	6.42	5.88	0.64	0.55	7.47	6.92	234.90	240.92
Thyme extract		28.75	27.29	14.83	16.00	6.73	6.67	0.72	0.54	7.96	7.86	247.33	252.14
Rosemary extract		29.50	28.20	15.92	16.42	5.75	6.02	0.67	0.56	7.48	8.46	248.77	260.50
Clove extract		30.08	31.25	13.72	16.70	7.00	7.00	0.70	0.63	7.09	7.48	241.06	243.30
Tebuconazole		27.50	25.50	12.98	15.16	5.25	5.75	0.63	0.62	6.10	5.98	218.41	225.01
Tricohdrema 34		30.42	29.50	12.83	16.30	6.50	5.25	0.68	0.60	6.69	7.11	208.92	223.63
Biochare		30.00	27.25	13.03	16.50	6.17	5.42	0.59	0.50	7.02	7.48	222.65	227.10
Water (control)		24.00	22.00	9.33	10.00	4.00	3.33	0.43	0.42	3.80	4.73	171.92	189.77
LSD at 5%		0.71	1.32	0.42	0.28	0.23	0.21	0.03	0.06	1.09	1.18	9.48	12.28
The interaction between the factors													
Dipping seeds	Ginger	26.00	25.00	12.17	16.11	6.33	5.75	0.63	0.55	7.13	7.00	215.45	222.52
	Thyme	29.00	27.33	14.89	15.00	6.25	7.00	0.73	0.55	7.55	7.41	231.86	244.74
	Rosemary	28.67	28.50	15.67	16.17	5.50	5.03	0.63	0.53	7.30	8.35	241.77	255.75
	Clove	30.67	31.00	13.07	16.73	7.00	6.00	0.70	0.60	6.65	7.20	234.34	231.66
	Tebuconazole	27.00	24.00	12.80	14.82	5.00	5.00	0.67	0.60	5.93	5.80	209.80	226.26
	Tricohdrema	30.33	29.00	12.39	16.40	6.50	5.50	0.67	0.60	6.48	7.55	206.20	211.97
	Biochare	29.00	26.00	12.23	16.00	6.00	5.33	0.55	0.45	6.76	7.23	217.09	221.91
	Control	24.00	22.00	9.17	10.00	4.00	3.33	0.43	0.42	3.80	4.73	171.92	189.77
Dipping seeds and drenching	Ginger	28.50	26.45	13.17	16.33	6.50	6.00	0.65	0.55	7.800	6.82	254.35	259.31
	Thyme	28.50	27.25	14.77	17.00	7.20	6.33	0.70	0.53	8.38	8.30	262.80	259.54
	Rosemary	30.33	27.89	16.17	16.67	6.00	7.00	0.70	0.58	7.65	8.57	255.77	265.24
	Clove	29.50	31.50	14.37	16.77	7.00	8.00	0.70	0.65	7.53	7.75	247.78	254.93
	Tebuconazole	28.00	27.00	13.17	15.50	5.50	6.50	0.60	0.63	6.27	6.17	227.02	223.76
	Tricohdrema	30.50	30.00	13.27	16.20	6.50	5.00	0.70	0.60	6.90	6.67	211.64	235.28
	Biochare	31.67	28.50	13.83	17.00	6.33	5.50	0.63	0.55	7.28	7.73	228.20	232.30
	Control	24.00	22.00	9.33	10.00	4.00	3.33	0.43	0.42	3.80	4.73	171.92	189.77
LSD at 5%	0.35	NS	0.21	0.14	0.11	0.10	0.02	NS	NS	0.23	4.63	5.99	

The Green Pods Yield and its Component of Snap Bean Plants

Effect of the Methods on Adding the Materials: Data in Table (7) illustrated the effect of the methods of adding the materials of some plant extracts and bio-control on the green pods yield and its component of snap bean plants. It is clear that, dipping seed before sowing and drenching plants three times during growing were the best treatments comparing to dipping seed before sowing only on pod fresh weight and the total green pods yield with significant increasing. Meanwhile, pod length, pod diameter and pod dry weight not reach to significant level and this may be due to that the green pod length and pod diameter of green snap bean cultivars controlled by genetic factors. These results were true in both growing seasons

Effect of the Materials Used: Data in Table (7) show a significant effect of the materials used on snap bean pods quality *i.e.* pod length, fresh and dry weight as well as the green pods yield. Meanwhile pod diameter not reaches to significant level because this character controlled by genetic factors. Moreover, data indicated that, Ginger, Thyme, Rosemary and Clove as well as bio-control (Tricohdrema 34 or Biochare) registered higher yield and best pods quality than the control or pesticide "Tebuconazole" treatments. It is observed that the total green pods yield significant increased from 3.748 and 3.569 ton/ fed with pesticide "Tebuconazole" to reach 6.614 and 6.825 ton/ fed with Rosemary extract, 6.511 and 6.378 ton/ fed with Ginger extract, 6.393 and 6.559 ton/ fed with Thyme extract, 5.265 and 5.135 ton/ fed with Clove extract, 5.326 and 5.965 ton/ fed with biochare as well as 5.545 and 4.775 ton/ fed with Tricohdrema 34 respectively in the two seasons. It can said that these treatments as shown in Table (3) showed obvious, increasing in plant growth which that reflect on yield and its components. These results agreements with those obtained by, Mohamedy and Abd-Alla [6] on green bean, El-Mohamedy *et al*. [7] on tomato and El-Mohamedy *et al*. [8]on green bean which reported that, application of biological control by using antagonistic microorganisms against root rot pathogens increased yield quantity.

Table 7: Effect of the methods of adding and using some plant extracts and bio-control treatments as well as their interaction between them on the green pods yield and its component of snap bean plants during two seasons of 2018 and 2019

Treatments		Pod length (cm)		Pod diameter (cm)		Pod fresh weight (g)		Pod dry weight (g)		Green pod yield/fed t/fed	
		2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
The methods of adding the materials											
Dipping seeds		14.44	14.26	0.78	0.77	5.66	5.51	0.507	0.488	5.0446	5.0927
Dipping seeds and drenching		14.44	14.30	0.79	0.78	6.11	5.74	0.522	0.511	5.3858	5.4734
LSD at 5%		NS	NS	NS	NS	0.12	0.10	NS	NS	0.135	0.3551
Materials used											
Ginger extract		14.22	14.44	0.79	0.81	5.95	5.82	0.505	0.510	6.5108	6.3795
Thyme extract		14.42	14.45	0.78	0.79	6.15	5.80	0.490	0.500	6.3927	6.5590
Rosemary extract		14.76	14.26	0.80	0.79	6.48	5.88	0.530	0.503	6.6143	6.8253
Clove extract		14.98	15.17	0.81	0.74	6.60	5.88	0.585	0.520	5.2650	5.1347
Tebuconazole		14.25	14.30	0.75	0.76	5.25	5.33	0.520	0.485	3.7480	3.5698
Tricohdrema 34		14.90	14.44	0.82	0.77	6.54	5.81	0.565	0.530	5.0545	4.7749
Biochare		14.99	14.75	0.79	0.80	5.20	5.93	0.553	0.550	5.3258	5.9650
Water (control)		13.01	12.42	0.76	0.76	4.90	4.55	0.370	0.400	2.8107	3.0560
LSD at 5%		0.32	0.74	NS	NS	0.81	0.36	0.109	0.113	0.157	0.160
The interaction between the factors											
Dipping seeds	Ginger	14.43	14.38	0.78	0.81	5.90	5.73	0.490	0.510	6.3310	6.0280
	Thyme	14.56	14.40	0.81	0.76	6.19	5.70	0.480	0.480	6.4277	6.2270
	Rosemary	14.55	14.25	0.81	0.80	6.30	5.80	0.510	0.487	6.5370	6.7330
	Clove	15.20	15.28	0.81	0.73	6.60	5.80	0.580	0.500	4.7300	4.8960
	Tebuconazole	14.27	14.15	0.73	0.75	5.00	5.00	0.520	0.480	3.5760	3.3877
	Tricohdrema	14.30	14.38	0.79	0.79	6.57	5.65	0.560	0.500	4.7120	4.4900
	Biochare	15.23	14.80	0.77	0.81	3.80	5.87	0.547	0.550	5.2327	5.9240
	Control	13.01	12.41	0.76	0.76	4.90	4.55	0.370	0.400	2.8107	3.0560
Dipping seeds and drenching	Ginger	14.00	14.50	0.79	0.81	6.00	5.90	0.520	0.510	6.6907	6.7310
	Thyme	14.28	14.50	0.81	0.82	6.10	5.90	0.500	0.520	6.3577	6.8910
	Rosemary	14.97	14.27	0.81	0.78	6.67	5.97	0.550	0.520	6.6917	6.9177
	Clove	14.75	15.05	0.81	0.74	6.60	5.96	0.590	0.540	5.8000	5.3733
	Tebuconazole	14.23	14.45	0.73	0.76	5.50	5.65	0.520	0.490	3.9200	3.7520
	Tricohdrema	15.50	14.50	0.79	0.74	6.51	5.97	0.570	0.560	5.3970	5.0598
	Biochare	14.75	14.70	0.77	0.78	6.60	5.99	0.560	0.550	5.4190	6.0060
	Control	13.01	12.41	0.76	0.76	4.90	4.55	0.370	0.400	2.8107	3.0560
LSD at 5%		0.15	0.08	NS	NS	0.40	0.08	NS	NS	0.076	0.078

Effect of the Interaction Between the Methods of Adding the Materials and the Materials Used: Recorded data in Table (7) illustrate that the interaction effect between the methods of adding the materials and the materials used induced significant effect on pod length, pod fresh weight as well as total green pods yield. Meanwhile pod diameter and pod dry weight not reached to significant level. The presented data revealed that, plants which treated with Rosemary extract by dipping seeds before sowing and drenching plants three times during growing gave the highest values of total green pods yield 6.692- 6.928 ton/ fed followed by Ginger extract 6.691- 6.731 ton/ fed and Thyme extract 6.358- 6.891 ton/ fed respectively in the two seasons.

Chemical Properties for Green Pods of Snap Bean as Well as Chlorophyll Leaf Contents

Effect of the Methods of Adding the Materials: The results illustrated in Table (8) showed the effect of the methods of adding the materials of some plant extracts and bio-control on N%, P%, K% and protein percentage in green pods as well as total chlorophyll concentration in the leaves of snap bean plants. The data reveal that the highest value with significant increase of N%% and protein percentage as well as total chlorophyll of leaves in both growing season and P% in the second season only were obtained with dipping the seeds before sowing and drenching plants three times during growing season.

Effect of the Materials Used: Data in Table (8) show a significant effect of the materials used i.e., plant extracts of Ginger, Thyme, Rosemary and Clove as well as bio-control (Tricohdrema 34 or Biochare) on N%, P%, K% and protein percentage in green pods as well as the total chlorophyll in the leaves of snap bean plants compared with the control or pesticide "Tebuconazole" treatments. This may be due to Rosemary contains more number of important compounds and Its extract contains antioxidant

Table 8: Effect of the methods of adding and some plant extracts and bio-control treatments as well as their interaction between them on chemical properties of green pods as well as chlorophyll concentration in the leaves of snap bean plants during two seasons of 2018 and 2019

		N%		P %		K %		Total protein %		Leaf chlorophyll reading SPAD	
Treatments		2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
The methods of adding the materials											
Dipping seeds		2.16	2.15	0.661	0.614	3.09	3.41	13.49	13.40	42.16	42.96
Dipping seeds and drenching		2.28	2.30	0.667	0.580	3.17	3.38	14.22	14.37	43.09	45.36
LSD at 5%		0.06	0.03	NS	0.016	NS	NS	0.35	0.0.67	0.465	0.29
Materials used											
Ginger extract		2.43	2.38	0.683	0.637	3.13	3.39	15.19	14.84	43.627	44.725
Thyme extract		2.54	2.46	0.728	0.668	3.39	3.75	15.89	15.38	44.675	45.55
Rosemary extract		2.31	2.38	0.738	0.553	3.31	3.63	14.43	14.84	44.010	46.265
Clove extract		2.45	2.51	0.715	0.650	3.32	3.65	15.28	15.71	43.700	45.115
Tebuconazole		2.07	2.07	0.594	0.547	2.99	3.19	12.96	12.96	40.100	41.985
Tricohdrema 34		2.12	2.16	0.803	0.694	3.08	3.29	13.23	13.47	41.350	43.425
Biochare		2.05	2.16	0.650	0.614	3.27	3.59	12.81	13.47	43.785	46.860
Water (control)		1.77	1.67	0.466	0.415	2.51	2.62	11.04	10.44	38.400	39.300
LSD at 5%		0.11	0.10	0.039	0.046	0.32	0.29	0.66	0.64	0.825	1.09
The interaction between the factors											
Dipping seeds	Ginger	2.32	2.32	0.718	0.654	3.04	3.31	14.50	14.500	42.923	44.200
	Thyme	2.49	2.38	0.679	0.648	3.43	3.85	15.54	14.875	43.850	44.33
	Rosemary	2.27	2.32	0.752	0.568	3.37	3.83	14.17	14.500	43.450	42.700
	Clove	2.46	2.49	0.737	0.640	3.12	3.47	15.38	15.542	43.000	44.430
	Tebuconazole	2.06	1.99	0.629	0.598	2.99	3.26	12.89	12.438	39.530	40.970
	Tricohdrema	2.02	2.00	0.863	0.733	3.01	3.24	12.65	12.500	40.570	42.250
	Biochare	1.88	1.99	0.563	0.655	3.22	3.59	11.75	12.438	42.800	45.470
	Control	1.77	1.67	0.466	0.415	2.51	2.62	11.04	10.44	38.400	39.300
Dipping seeds and drenching	Ginger	2.54	2.43	0.648	0.619	3.22	3.49	15.88	15.188	44.330	45.250
	Thyme	2.60	2.54	0.776	0.687	3.36	3.64	16.25	15.875	45.500	46.770
	Rosemary	2.35	2.43	0.723	0.538	3.25	3.44	14.69	15.188	44.570	49.830
	Clove	2.43	2.54	0.693	0.660	3.52	3.83	15.19	15.875	44.400	45.867
	Tebuconazole	2.08	2.16	0.558	0.495	3.01	3.14	13.02	13.479	40.670	43.000
	Tricohdrema	2.21	2.31	0.742	0.655	3.16	3.35	13.81	14.438	42.130	44.600
	Biochare	2.22	2.32	0.737	0.572	3.32	3.59	13.88	14.500	44.770	48.250
	Control	1.77	1.67	0.466	0.415	2.51	2.612	11.04	10.44	38.400	39.300
LSD at 5%		0.05	0.05	0.019	0.023	NS	NS	0.32	0.31	0.403	0.534

compounds, the most active obtained by phenolic diterpenes, such as carnosic acid, carnosol, rosmanol, epirosmanol, isorosmanol, methylcarnosate and rosmarinic acid as mentioned by Solomakos *et al.* [12]; Satyal *et al.* [13] and Sirocchi *et al.* [14]. On the other hand, Nychas [17]; Solomakos *et al*. [12] and Gonsalves *et al*. [18], reported that, thyme contains more than 60 components of critical compounds such as the phenols, antiseptic, carminative, antioxidant and antimicrobial properties These results agreements with those obtained by Shan *et al*. [19]; Hu and Willett [20] which they reported that the effective role of clove in the inhibition of different degenerative diseases is attributed to the presence of various chemical constituents in high concentrations with antioxidant activity. Also, Mohamedy and Abd-Alla [6] on green bean; El-Mohamedy *et al*. [7] on tomato and El-Mohamedy *et al*. [8] on green bean reported that, application of biological control using antagonistic microorganisms against seed and root rot pathogens increased nutritional values.

Effect of the Interaction Between the Methods of Adding the Materials and the Materials Used: Data in Table (8) revealed that all treatments resulting in the interaction effect between the methods of adding the materials and the materials used in two seasons significantly increased total nitrogen (%), Phosphorus (%) and protein percentage in green pods as well as total chlorophyll in the leaves of snap bean plants compared with the control treatment, while all treatments gave no significant values of the Potassium % in both growing season. The most effective treatment on total nitrogen (%) and protein percentage in green pods was from Thyme extract with dipping the seeds before sowing and drenching plants three times during growing season in addition the total chlorophyll in leaves in the first season.

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