Effect of some natural products on productivity and some pests of cabbage

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ABSTRACT:

The study were conducted during two consecutive seasons of 2018 and 2019 in a private farm at Marsa Matrouh Governorate which located in on Egypt northwest Mediterranean coast (latitude 31^{o} 21' N, longitude 27^{o} 14' E) to evaluate the effects of Kaolin (Aluminum phyllosilicate [$Al_2Si_2O_5$ $(OH)_4$]), Bentonite (Calcium aluminosilicate [$Al_2O_3SiO_2H_2O$]), Atabouglite (Magnesium aluminosilicate [$Al_2Mg_3O_{18}Si_6$]) products as well as chloropyrophose pesticide as foliar spraying and potassium fertilizers as soil additives on cabbage growth, yield, quality and pests control. Although foliar spray treatments did not have any significant effect on growth characters, chemical insecticide treatment produced the highest average head weight and highest yield compared with other foliar spray treatments. High rate of potassium supply as 75 kg gave the best value of growth and yield as well as quality characters followed by 50 kg then 25 kg compared with control treatment which produced the lowest values. Cabbage plants treated as foliar spraying with atabouglite, kaoline formulations exhibited high

decrease of aphid population compared with bentonite application which gave the least potential towards adult of aphid insects. Also, atabouglite had a superior effect on average cumulative cotton leaf worm *Spodoptera littoralis* (Boisd) infestations of leaves and larvae followed by Kaolin. Bentonite had the lowest effect. While, chloropyrophos (chemical treatment) reduced the infestations in highly effect compared with all treatments.

Kay wards: Cabbage, Kaolin, bentonite, atabouglite, potassium application, growth and yield, cotton leaf worm and aphid .

INTRODUCTION:

White cabbage is considered the most important leafy vegetable crop in Egypt (total area for cabbage and other brassicas is about17250 ha and total production is about 525410 ton, **FAO, 2018**). It considered a rich source of vitamin C and has high fiber and calcium content which reduces the risk of colon cancer. Moreover, contains phosphorus, which is helpful in utilization of calcium and assimilation of carbohydrates and fats in human body **(Mohammadullah *et al.*, 2020)**.

The environmental problems caused by excessive use of pesticides have been the matter of concern for most researchers. The reasons for this referred to toxicity, non-biodegradable properties and the residues of pesticides in the soil, water resources pollution which in turn effect on human health **(Koul, *et al.*, 2008)**. Thus, the current global scenario firmly emphasizes the need to adopt eco-friendly agricultural practices for sustainable food production because the problems associated with the use of hazardous chemicals for crop protection, weed control and soil fertility increasing worldwide **(Abou-Hussein, 2001; Ferrari *et al.*, 2008; Gomaa, 2008)**. Natural products are promise and excellent alternative to synthetic pesticides as a means to reduce negative impacts to human health and the

environment **(Isman and Machial, 2006)**. In this respect, the encouragement of products from natural resources and even the extremely biodegradable synthetic and semisynthetic products in pest management, has been considered to constitute the umbrella of green pesticides **(Koul *et al*., 2003; Dhaliwal and Koul, 2007; Koul, 2008)**.

Kaolin (Aluminum phyllosilicate), Bentonite (Calcium aluminosilicate) are naturally occurring industrial rock, characterized by the property of absorbing water and by capacity for base exchange. But bentonite properties are significantly greater than that of kaolin **(Kutlic *et al*., 2012)**. Both of them as well as Atabulit (Magnesium aluminosilicate) considered a clay minerals which have chemical inert over a wide range of pH and a low exchangeable captain capacity (1-16 meq/100g) **(Brown *et al*., 2010)**. Recently many researchers used this clay minerals as a natural products which creates a protective mechanical barrier against plant pathogenic diseases and pests when sprayed on the plant surface as particle film **(Lamb *et al*., 2002; Liang and Liu, 2002; Reitz *et al*., 2008 and Crooks and Prentice, 2011)**. Moreover, its effect on leaf temperature and photosynthetic rate (**Gindaba and Wand**, **2007)**, increased leaf water potential and decreased stomatal conductance (**Glenn *et al*., 2010)** and consequently may decrease growth and yield of some plants when sprayed with high concentrate (**Javan *et al*., 2013)** or increase growth and yield of others when sprayed with moderate concentrates **(Mohadeseh *et al*., 2013)**. These eco-friendly material must be combine with the good agricultural practices especially mineral nutrients which plays a critical role in plant stress resistance **(Cakmak, 2005; Amtmann et al., 2008 and Romheld, and Kirkby 2012)**.

Out of all the mineral nutrients, potassium plays a particularly critical role in plant growth and metabolism, and it

contributes greatly to the survival of plants that are under various biotic and abiotic stresses **(Wang *et al*., 2013)**. Potassium is also essential for the loading and transport of the sugar produced to developing fruits and roots. Its also enhancing crop resistance to stresses including insects, pests and various diseases, as well as drought and frost and is beneficial in extending the keeping quality of crops **(Cakmak, 2005 and Srivastava *et al*., 2018)**. Moreover, potassium is one of the essential elements in the plant and one the three that is generally needs to supplied as fertilizers. It has been clearly that, plants need to high amounts of potassium for high yield with improve its quality. The application of potassium at the rate of 100 kg k_2o /ha is necessary to obtain high yield of cabbage, **(Wijewardena and Amarasiri, 1997)**, 224 kg/ha (**Cutcliffe, 1984)** or 60 kg k_2o / he. **(Khan, *et al*., 2002)**, depending on initial potassium content of the soil, where, the actual soil concentrations of this element ranging from 0.04 to 3 per cent **(Chaitanya, *et al*., 2019)** depends on the type of parent material and degree of mineral weathering **(Sparks and Huang, 1985)**. Thus, with increasing level of potassium, yield and quality parameters of cabbage increasing **(Chaitanya, *et al*., 2019)**. Supplying potassium abundantly absorbed luxuriously without affecting the cabbage-head yield, compared with nitrogen and phosphorus which reduce the cabbage-head yield when supplied abundantly **(Hara, and Sonoda a (1979)**. Although, phosphorus supply until cabbage head initiation is enough for the normal development of a cabbage-head, potassium supply is necessary at the later as well as early growth stages **(Hara and Sonoda b, 1979)**. In addition that its role on growth and yield, potassium plays important roles in enzyme activation, protein synthesis, photosynthesis, osmoregulation, stomatal movement, energy transfer, phloem transport, cation-anion balance and stress resistance **(Marschner, 2012)**, which in turn reflect on quality and pest resistance of produce. The aim

of this work was to evaluate the effect of some natural substances such as Kaoline, Bentonite and Atabouglite as foliar spray as well as soil potassium supplies on cabbage growth, yield and control of some cabbage pests.

MATERIALS AND METHODS: The study were conducted during two consecutive seasons of 2018 and 2019 in a private farm at Marsa Matrouh Governorate which located in on Egypt northwest Mediterranean coast (latitude 31^{o} 21' N, longitude 27^{o} 14' E) to evaluate the effects of Kaolin (Aluminum phyllosilicate [$Al_2Si_2O_5$ $(OH)_4$]), Bentonite (Calcium aluminosilicate [$Al_2O_3SiO_2H_2O$]), Atabouglite (Magnesium aluminosilicate [$Al_2Mg_3O_{18}Si_6$]) products as well as chloropyrophose pesticide as foliar spraying and Potassium fertilizers as soil additives on cabbage growth, yield and quality. Two factors were tested, the first included five foliar treatments, control (tap water), kaolin at concentration of 2%, bentonite at 2 % and atabouglite at 2% and chloropyrophose at 2 cm /liter. While the second factor included, potassium sulfate at 150, 100 and 50 kg /fed as well as control (without addition). Traditional agricultural practices of cabbage baladi cv. has done. Recommended dose of mineral fertilizers (90 and 60) units of N and P during growing seasons were added. the experimental plot contain one line 1 m width and 10.5 m length and every plot contain 17 plants. The foliar spraying was applied after 20 days from transplanting and repeated every 20 days (four times) while fertilizer amounts were applied at the same time as 20%, 20%, 30% and 30% of treatment weight.

Data Recorded/Growth Characters:

After 60 days from transplanting, five plants were randomly taken from each experimental plot to record growth characters *i.e.* plant height, leaves number, fresh and dry weight (g) of plant.

Yield and its component:

At harvest (90 days after transplanting), cabbage plants which formed marketable heads were counted, weighted then, diameter and compactness index were measured. Early yield was determined then other characters weakly repeated fourth.

Chemical component:

potassium content and dry matter percent were determined in leaves according to **AOAC (1990)**.

Insect observations: Samplings of cabbage leaves with three replicates were arranged in a split plot design. Samples of 25 leaves from each replicate representing different levels and directions of the plants were randomly collected to investigate cabbage insects that attacking plants **(Sharaby *et al.* 2015)**. For all treatments, samples of infested leaves were collected immediately before spraying as index of pre – treatment count, and every 20 days after the successive sprays to determine the level of infestation. The collected samples were kept in paper bags in a refrigerator till examined by the use of a binocular microscope. They were separated, identified and counted. The percentage of reduction in infestation was calculated according to the formula **(Topps and Wain, 1957)**.

$$R\,\% = \frac{C - T}{C} X\,100$$

Where:

C: Number of insects recorded in the control samples.

T: Number of insects recorded in treatment samples.

Experimental design and statistical analysis:

Split plot design with three replicates was used, where, foliar spray treatments were placed in main plot, while potassium application treatments occupied sub-plots. Data were subjected to statistical analysis according to **Thomas and Hills (1975)**. The differences among means were performed using least significant difference (LSD) at 5% level.

RESULTS AND DISCUSSION:

Growth characters: The effect of natural products foliar spray treatments, potassium supply and interaction between them on plant height, leaves number and plant fresh weight are shown in table (1). All foliar spray treatments did not have any significant effect on growth characters, except plant height in the first season, where, insecticide treatment produced the highest plants compared with other treatments. Both insecticide and control treatments had a slight increasing of plant fresh weight compared with other treatments, but this increasing was not significant in both seasons. On the contrary, control treatment (without potassium supply) compared with other potassium treatments produced the lowest values of plant height, leaves number and plant fresh weight in both seasons. In this respect, high rate of potassium supply as 75 50 kg gave the best value followed by 50 kg then 25 kg. Regarding interaction effects, all interaction effects were significant in both seasons. The most pronounced effect was increasing plant height and plant fresh weight when cabbage plants treated with high concentrates of potassium with pesticide or control treatments compared with without potassium treatment with all foliar spray treatments in both seasons. Relatively decreasing of growth when natural products used may be due to that, used of clay minerals as a natural products which creates a protective mechanical barrier when sprayed on the plant surface as particle film have strongly effect on leaf temperature and photosynthetic rate **Gindaba and Wand (2007)**, increased leaf water potential and decreased stomatal conductance **Glenn *et al*., (2010)** and consequently may decrease growth and yield plants **Javan *et al.*, (2013).** On the other hand increasing growth characters with increasing potassium supply was expected and agree with **(Wijewardena**

and Amarasiri, 1997; Cutcliffe, 1984; Khan, *et al.*, 2002 and Chaitanya, *et al.*, 2019).

yield and its component:

Data presented in table (2) showed that, number of marketable heads, average head weight and total yield per plot significantly affected by foliar spray treatments, potassium supply and interaction between them in both seasons. Insecticide treatment produced the highest number of marketable heads and total yield per plot followed by kaolin treatment then other natural products, while, foliar spay control treatment gave the lowest number of marketable heads and lowest total yield per plot in both seasons. Also, insecticide treatment gave the highest average head weight compared with other foliar spray treatments in both seasons. Concerning potassium supply treatments, both 75 and 50 kg gave the highest value of marketable heads number, average head weight and total yield followed by 25 kg treatment compared with control (without potassium supply) which gave the lowest value in this respect in both seasons. Moreover, high potassium rates 75 and 50 kg with insecticide foliar spray treatment gave the highest values compared with control and 25kg of potassium especially with atapolite and bentonite foliar spray treatments.

The superiority of natural products on yield may be attributes for its effect on cabbage pest control which consequently reflected on number of marketable units per plot and total yield. many researchers reported that, clay minerals creates a protective mechanical barrier against plant pathogenic diseases and pests when sprayed on the plant surface as particle film **(Lamb *et al.*, 2002; Liang and Liu, 2002; Reitz *et al.*, 2008 and Crooks and Prentice, 2011)**. These eco-friendly material must be combine with the good agricultural practices especially mineral nutrients which plays a critical role in plant stress resistance **(Cakmak, 2005; Amtmann *et al.*, 2008 and Romheld, and Kirkby 2012)**.

Table (1): Effect of natural products foliar spray and potassium supply on plant height, leaves number and plant fresh weight sixty days after transplanting

Characters		Plant height (cm)		Leaves no.		Plant F.w.(g)	
Seasons		1 st	2nd	1 st	2nd	1 st	2nd
Foliar spray							
Atabouglite		42.49	44.65	17.08	17.99	817.4	826.7
Bentonite		42.26	45.05	17.23	18.14	816.2	807.1
Kaolin		42.19	45.39	17.09	18.13	807.2	816.2
Insecticide		46.29	46.29	17.11	18.18	838.0	828.4
Control		42.95	46.29	17.01	18.13	838.8	863.3
LSD at 0.05		1.04	N.S	N.S	N.S	N.S	N.S
Potassium							
75 kg k_2o		45.60	48.41	18.36	19.24	840.4	852.0
50 kg k_2o		45.20	46.99	18.35	18.80	844.0	841.6
25 kg k_2o		43.42	46.31	17.04	18.74	848.9	849.3
Control		38.73	40.43	14.67	15.68	760.9	770.4
LSD at 0.05		0.78	1.02	0.39	0.41	22.4	21.1
Interaction							
Atabouglite	75 kg k_2o	45.66	47.36	18.26	19.24	832.3	846.3
	50 kg k_2o	44.35	46.00	18.30	18.81	821.1	839.3
	25 kg k_2o	43.43	45.94	17.12	18.60	853.9	865.1
	Control	36.53	39.28	14.65	15.31	762.4	756.0
Bentonite	75 kg k_2o	45.23	47.36	18.76	19.00	829.9	832.3
	50 kg k_2o	44.97	46.69	18.54	18.68	832.5	831.2
	25 kg k_2o	42.08	45.94	16.96	19.07	845.2	831.8
	Control	36.77	40.22	14.65	15.81	757.1	733.1

Kaolin	**75 kg k_2o**	45.23	48.71	18.39	19.34	825.5	848.8
	50 kg k_2o	44.96	46.73	18.62	18.72	822.1	832.6
	25 kg k_2o	42.08	45.94	16.70	18.66	820.6	815.9
	Control	36.49	40.19	14.65	15.81	760.8	767.5
Insecticide	**75 kg k_2o**	45.64	48.93	18.26	19.31	856.7	849.6
	50 kg k_2o	45.93	47.50	18.12	19.13	888.8	865.9
	25 kg k_2o	46.54	47.09	17.06	18.69	837.5	835.8
	Control	47.05	41.63	15.02	15.61	769.1	762.5
Control	**75 kg k_2o**	46.24	49.69	18.11	19.24	857.5	882.9
	50 kg k_2o	45.78	48.00	18.19	18.80	855.4	839.2
	25 kg k_2o	42.96	46.61	17.34	18.74	887.3	898.0
	Control	36.83	40.85	14.40	15.68	755.1	832.9
LSD at 0.05		**1.75**	**2.28**	**0.87**	**0.92**	**50.1**	**47.1**

Moreover, potassium supply enhanced cabbage growth and yield. This referred to its important roles in enzyme activation, protein synthesis, photosynthesis, osmoregulation, stomatal movement, energy transfer, phloem transport, cation-anion balance and stress resistance **(Marschner,2012)**, which in turn reflect on quality and pest resistance of produce. So, the application of potassium produced high yield of cabbage, **(Wijewardena and Amarasiri, 1997; Cutcliffe, 1984; Khan, *et al.*, 2002). (Chaitanya, *et al*., 2019)**.

Table (2): Effect of natural products foliar spray and potassium supply on number of marketable heads, average head weight and total yield per plot

Characters		No. of marketable heads		Average head weight (g)		Total yield /plot (kg)	
Seasons		1 st	2nd	1 st	2nd	1 st	2nd
Foliar spray							
Atabouglite		14.50	13.33	4035	4208	58.65	56.17
Bentonite		14.58	13.25	4010	4171	58.50	55.39
Kaolin		15.00	14.00	4030	4214	60.55	59.14
Insecticide		16.08	16.08	4146	4347	67.03	70.11
Control		13.58	12.75	4019	4137	54.75	52.84
LSD at 0.05		**0.97**	**0.77**	**80**	**85**	**4.56**	**3.62**
Potassium							
75 kg k_2o		15.20	14.60	4175	4290	57.31	62.72
50 kg k_2o		15.24	14.60	4225	4332	60.81	63.36
25 kg k_2o		15.33	14.53	4032	4199	57.45	61.10
Control		13.27	11.80	3760	4040	43.43	47.73
LSD at 0.05		**0.52**	**0.47**	54	61	2.43	2.04
Interaction							
Atabouglite	**75 kg k_2o**	15.00	14.00	4139	4216	62.11	59.00
	50 kg k_2o	14.67	13.67	4187	4293	61.44	58.64
	25 kg k_2o	15.00	14.33	4034	4214	60.60	60.42
	Control	13.33	11.33	3780	4111	50.46	46.62
Bentonite	**75 kg k_2o**	14.67	14.33	4133	4284	60.64	61.39
	50 kg k_2o	14.33	14.00	4221	4231	60.50	59.24
	25 kg k_2o	15.33	13.33	3932	4168	60.31	55.59

	Control	14.00	11.33	3753	3999	52.54	45.35
Kaolin	**75 kg k_2o**	15.33	14.33	4154	4299	63.72	61.60
	50 kg k_2o	15.67	15.00	4203	4362	65.86	65.42
	25 kg k_2o	15.00	15.00	3998	4183	59.97	62.69
	Control	14.00	11.67	3765	4013	52.65	46.84
Insecticide	**75 kg k_2o**	17.67	17.33	4255	4425	73.77	76.69
	50 kg k_2o	17.00	17.33	4274	4488	72.66	76.30
	25 kg k_2o	16.33	16.67	4278	4334	71.32	72.25
	Control	13.67	13.33	3778	4140	50.36	55.21
Control	**75 kg k_2o**	13.33	13.00	4194	4225	57.31	54.93
	50 kg k_2o	14.00	13.33	4242	4288	60.81	57.21
	25 kg k_2o	14.00	13.33	3917	4096	57.45	54.56
	Control	13.33	11.33	3724	3940	43.43	44.65
LSD at 0.05		**1.17**	**1.05**	**120**	**137**	**5.44**	**4.55**

Quality characters:

The effect of natural products foliar spray, potassium supply treatments and their interactions on compactness index, dry matter percent and potassium content were shown in table (3) . foliar spray treatments had not significant effects on this characters, except dry matter percent and potassium content in first season, where, insecticide and control treatments increased both characters compared with other foliar spray treatments. Regarding potassium supply treatments effect, high rates 75 and 50kg gave the highest value of compactness index followed by

25 kg treatment, while control of potassium treatments gave the lowest value. All potassium treatments gave the highest dry matter percent and potassium content compared with control which gave the lowest values in both seasons. Moreover, interaction effects were significant on compactness index, dry matter percent and potassium content. High potassium rates with insecticide foliar spray treatment gave the highest values, while without potassium treatment (control) with all foliar spray treatments gave the lowest values in both seasons. Increasing of compactness index because, potassium supply improved average head weight, while the average head diameter was relatively constant which reflected on compactness value. Also, dry matter and potassium content increasing with increasing of potassium supply which in turn enhancement head cabbage quality and resistance for pests. Similar results were found by **(Hara and Sonoda a (1979); Cakmak, 2005; Amtmann *et al*., 2008 and Romheld, and Kirkby, 2012 and Marschner, 2012)**.

Table (3): Effect of natural products foliar spray and potassium supply on compactness index, dry matter percent and potassium content

Characters	Compactness index		Dry matter %		Leaves potassium content	
Seasons	**1 st**	**2nd**	**1 st**	**2nd**	**1 st**	**2nd**
Foliar spray						
Atabouglite	121.6	127.5	12.20	12.71	3.17	3.42
Bentonite	122.7	126.5	12.16	12.75	3.18	3.41
Kaolin	121.8	124.8	12.12	12.72	3.26	3.44
Insecticide	125.4	128.2	12.83	13.21	3.39	3.52
Control	118.3	125.4	12.95	13.01	3.33	3.45
LSD at 0.05	**N.S**	**N.S**	**0.23**	**N.S**	**0.11**	**N.S**
Potassium						
75 kg k_2o	129.4	133.3	12.84	13.37	3.50	3.61

50 kg k_2o		127.4	132.0	12.77	13.33	3.47	3.56
25 kg k_2o		121.9	126.2	12.82	13.29	3.37	3.60
Control		109.1	114.4	11.37	11.54	2.72	3.02
LSD at 0.05		**2.7**	**2.7**	**0.17**	**0.22**	**0.08**	**0.11**
Interaction							
Atabouglite	**75 kg k_2o**	125.9	131.8	12.63	13.43	3.41	3.57
	50 kg k_2o	130.2	130.4	12.35	12.93	3.34	3.56
	25 kg k_2o	122.9	132.9	12.37	13.05	3.18	3.54
	Control	107.5	114.8	11.44	11.44	2.76	3.00
Bentonite	**75 kg k_2o**	128.4	132.9	12.41	13.37	3.36	3.53
	50 kg k_2o	131.2	132.8	12.32	13.15	3.46	3.51
	25 kg k_2o	124.8	126.0	12.66	13.14	3.26	3.57
	Control	106.5	114.6	11.26	11.34	2.65	3.03
Kaolin	**75 kg k_2o**	132.5	132.7	12.48	13.07	3.56	3.56
	50 kg k_2o	126.1	131.0	12.41	13.41	3.42	3.62
	25 kg k_2o	120.7	122.8	12.32	13.21	3.38	3.67
	Control	108.2	112.6	11.29	11.17	2.66	2.90
Insecticide	**75 kg k_2o**	133.8	135.3	13.42	13.60	3.65	3.82
	50 kg k_2o	125.9	136.2	13.32	13.69	3.61	3.69
	25 kg k_2o	122.9	125.2	13.30	13.73	3.56	3.59
	Control	119.1	116.3	11.27	11.84	2.73	2.99
Control	**75 kg k_2o**	126.6	133.6	13.28	13.38	3.53	3.56

50 kg k_2o	123.8	129.8	13.45	13.48	3.54	3.44
25 kg k_2o	118.4	124.1	13.45	13.29	3.49	3.61
Control	104.4	114.0	11.61	11.54	2.77	3.17
LSD at 0.05	**6.1**	**6.0**	**0.38**	**0.49**	**0.18**	**0.25**

Effect of ataboglite, kaolin and bentonite against some cabbage pests:

1.Treatments on cotton leaf worm *Spodoptera littoralis* (Boisd).

The obtained data in Table (4) indicated that infestation was significantly lower in the treated plants than untreated ones. The results in Table (4) cleared that the atabouglite was the superior effect on average cumulative cotton leaf worm *Spodoptera littoralis* (Boisd) infestations of leaves and larvae. Kaolin was the second potential effect after atabouglite . Bentonite was lowest effect . These results agreed with **Ali (2016)** who found that kaolin and bentonite product in different concentrations suppressed olive fruit fly infestations. Particle film technology has emerged as a new method for controlling arthropod pests and diseases of agricultural crops **Glenn *et al*. (1999)**.

Table (4): Effect of foliar treatments on cotton leaf worm *Spodoptera littoralis* (Boisd) on cabbage

Foliar Treatments	Infestations			
	Leaves		Larvae	
	Mean	R%	Mean	R%
Control	8.3		9.6	
Atabouglite	2.4	71.1%	1.9	80.2%
Kaoline	2.8	66.3%	2.7	71.8%
Bentonite	5.2	37.3%	5.7	40.6%
Chloropyrophose	0.2	97.5	0.1	99.0

R % = Reduction percentage

2- Effect of foliar spraying on aphid (*Aphis crassivora*)

The data illustrated in table (5) presented that, the foliar spraying revealed significantly lower infestation of aphid insects in the treated plants than untreated ones. The evaluation of aphid infestation on cabbage plants implemented prior to natural products atabouglite, kaoline and bentonite treatments which gave acceptance effects against adults of aphid population on the final results across the treatments. The cabbage plants treated as foliar spraying with atabouglite, kaoline formulations exhibited high decrease of aphid population that was statistically similar to the infestation prior to the treatment that produced the greatest reduction in the leaves and adult infestations. The bentonite application was the least potential towards adult of aphid insects. The chloropyrophos reduced the infestations in highly effect. On the other hand, the untreated control recorded higher infestations of mealy bug insects. These results were in agreement with those obtained by **Marko *et al*. (2008),** who mentioned that kaolin treatment reduced the population density of *Aphis pomi*, *Anthonomus pomorum*, and *Empoasca vitis*, and the number of communal caterpillar webs. Also the results can be similar with **Soubeih *et al*. (2017)** cleared that and kaolin as foliar spraying were the superior effect at 5% concentration on cumulative leafminer, aphid infestations and early blight disease incidence and severity.

Table (5): Effect of foliar spraying on aphid (*Aphis crassivora*) on Cabbage

Foliar Treatments	Infestations			
	Leaves		Adult	
	Mean	R%	Mean	R%
Control	12.5		15.4	
Atabouglite	1.8	85.6%	1.8	88.3
Kaoline	2.4	80.8%	2.3	84.1%
Bentonite	6.5	48.0%	6.3	59.0%

Chloropyrophose	0.3	97.6	0.1	99.4

R % = Reduction percentage

CONCLUSION:

Potassium application as soil fertilizers at 75 or 50 kg k_2o enhanced cabbage growth, increased number of marketable heads and consequently increased cabbage yield. Also, using natural clay compounds as alternative of chemical treatments increased number of marketable heads and increased cabbage yield compared with control. Spraying with atabouglite, kaoline formulations exhibited high decrease of aphid and cotton leaf worm population compared with bentonite application which gave the least potential. While, chloropyrophos (chemical treatment) reduced the infestations in highly effect compared with all treatments.

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