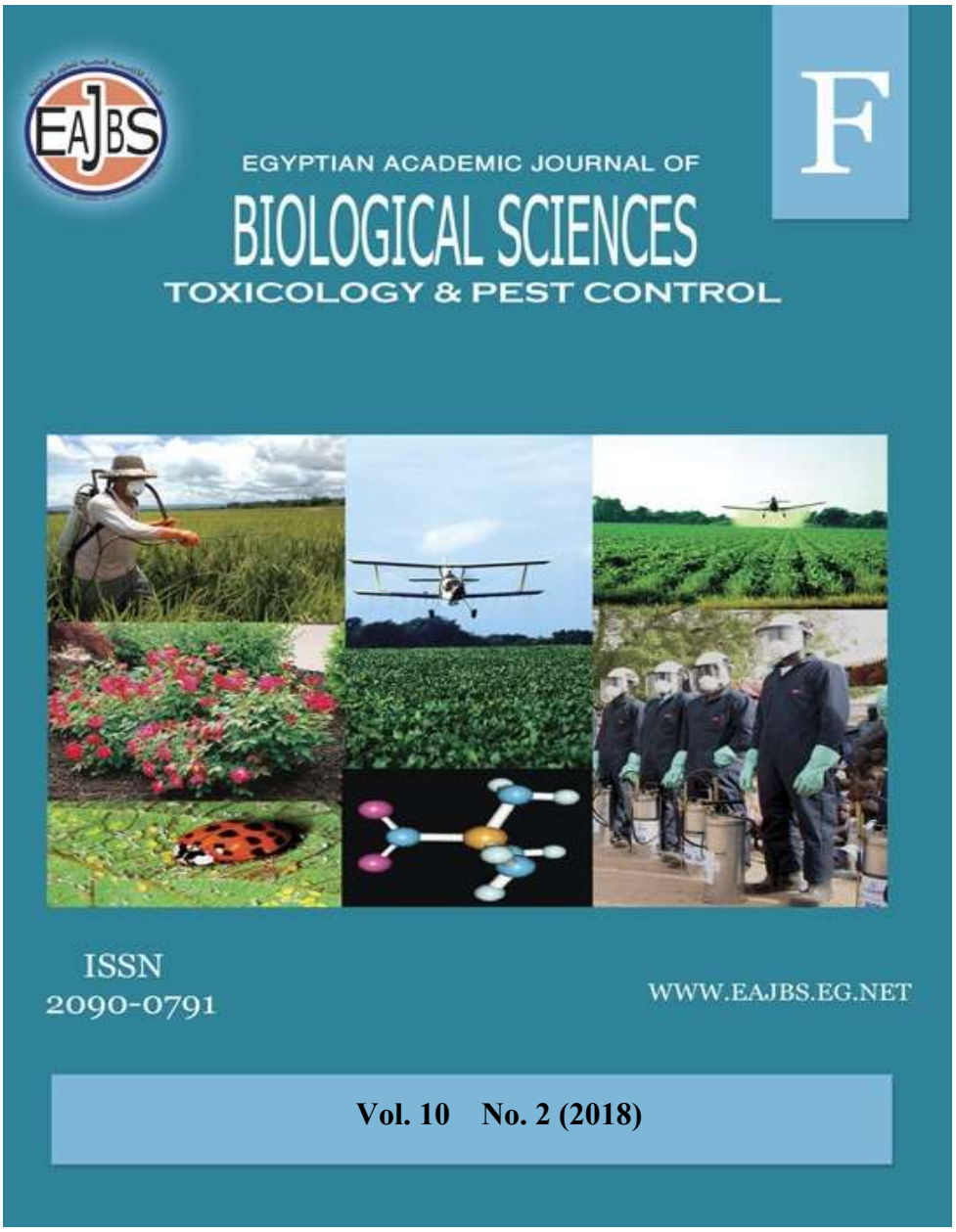

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Some Field Applications for Controlling *Tuta absoluta* Meyrick (Lepidoptera;Gelechiidae) in Egypt

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ABSTRACT

The tomato leafminer, *Tuta absoluta* (Meyrick), is one of the key pests of tomato crop in Egypt. Chemicalcontrol and essential aromatic oils had been the main method of controlling it. However, the study aims to evaluated chemical pesticide, essential aromatic oils (Garlic, Dill) and mineral oil alone and in binary mixtures, to identify their impact on the population densities of *T. absoluta* insect pest as well as their effects on the yield of tomato. The results showed that during the two seasons 2017 and 2108, the leafminer, *T. absoluta* recorded three generations in both seasons. When using chemical pesticide, essential aromatic oils (Garlic, Dill) and mineral oil alone and in binary mixtures found highly significant differences between the thirteen tested compounds. The pest control were using 4cm Coragen 20% SC / 25cm mineral oil, 3cm Coragen 20% SC / 25cm mineral oil, 4cm Voliam Flexi 40% WG / 25cm mineral oil and 40cm Dill oil / 25cm mineral oil showed highly mortality .the low effect was using 20cm Garlic oil / 25cm mineral oil.

INTRODUCTION

Tomato leafminer, *T. absoluta* Meyrick (Lepidoptera: Gelechiidae) is an important pest of tomato (Husseine*t al*., 2014). After its initial detection in eastern Spain in 2006, it was rapidly invaded various other European countries and spread throughout the Mediterranean basin (Desneux*et al.*, 2010). Currently, Egyptian tomato fields were infested with *T. absoluta* since 2009 and it became one of the economic pest attacked tomato and other Solanaceous plants (NAPPO, 2012).

T. absoluta larvae can cause yield losses of up to 80 - 100% by attacking tomato leaves, flowers, stems, and especially fruits of tomato crops in both greenhouse and open field (Desneux*et al*., 2010). Synthetic pesticides are currently the most effective means of pest control. However, the unceasing and indiscriminate uses of these substances have not only caused adverse effects on mammals' health, but have also affected many other non-target organisms (Bughio and Wilkins, 2004). They are also responsible for the development of insecticide-resistance phenomenon (Suinaga*et al*., 1999; Lietti*et al*., 2005). However, extracts and pure compounds isolated from different plants could be used for controlling insect pests. Natural product-based pesticides can sometimes be specific to the target species and have unique modes of action (Duke *et al*., 2003). Plant products have several uses in insect control (Trindade*et al*., 2000; Moreira *et al*., 2004; Farghaly*et al*., 2009; Moreno *et al*., 2011;

Salari*et al*., 2012). These products have also been studied for acute toxicity, anti-feedant, or repellent, and fumigant effects, as well as inhibiting reproduction of many pest species (Ben*et al*., 2010).

Petroleum-derived horticultural mineral oils (HMOs) have been used for pest control for well over a hundred years, initially as dormant oil sprays for deciduous tree crops. Their use as foliar sprays has increased as improvements in purity and surfactants have improved efficacy and reduced risks of phyto-toxicity (Davidson *et al*., 1991). Oils are thought to act directly on insects by blocking the spiracles and causing suffo- cation (Stansly*et al*., 1996). An additional effect brought about by coating of olfactory receptor organs may cause interference with host location (Simons, 1982),

Some of tropical plants extracts were used for pest control as *Acmellaoleracea* extract which showed high insecticidal activity and could be used to control *T. absoluta* (Moreno *et al*., 2011). However, plant extract can be increased capability for activating defense responses of plants. Also, Garlic and Ginger extracts were much effective against some pests of Cowpea (Ben*et al*. 2010). Garlic showed the highest effects on *T. absoluta* second instar larvae while; basil leaves extract exhibited the least effect (Ghanim and Abdel Ghani, 2014). On the other hand, essential aromatic oils were used for control many pests on various crops. Further, while resistance development continues to be an issue for many synthetic pesticides, it is likely that resistance will develop more slowly to essential oil-based pesticides owing to the complex mixtures of constituents that characterize many of these oils (Koul*et al*., 2008).

This study aims to evaluated chemical pesticides, essential oils and mineral oil alone and in binary mixtures, to identify their impact on the population densities of *T. absoluta* in two successive seasons (2017 and 2018). Control was sprayed only by water.

MATERIALS AND METHODS

Field Experiment:

The field experiment was carried out in Moshothor farm that belongs to; Banha University, Qalubiya Governorate, under open field conditions. Experimental area (approximately 900 m^2) was planted with tomato *Lycopersicon esculentum* (Mill.) variety 'Super Strain B' after seeded in a greenhouse and then transferred to the field during summer cultivation seasons (March 2017 and 2018), under normal field and agricultural practices. Inspection was started 15 days after sowing, and continued weekly till the harvest period. Numbers of *T. absoluta* egg and larvae were counted on ten leaves that were collected randomly per replicate at early morning. These samples were kept in paper bag and transferred to be examine in the laboratory and count the numbers of each investigated pest species.

Number and Duration of Generations:

The number of pests on tomato leaf were weekly counted throughout two successive seasons and taken in consideration to estimate the number and duration of seasonal field generations of different pests on tomato at Moshothor- Qalubiya Governorate. The method suggested by Audemard and Milaire (1975) and by Iacob (1977) was applied. The graphical representation of figures on semi-Gaussion paper (scale gauss) shows the number of generations for each species represented by regression lines.

Toxicity of Certain Compound:

The aim of this experiment is to evaluate the degree of infestation by leafminer, *T. absoluta* under field condition of the tested treatment. The experiment block design was randomized with each treatment replicated three times. Each plot had five rows with 25 plants. The plant space was 0.5x1.0 m. The Treatments in Table (1) were applied as foliar spray on May 15, 2017 and in 2018. The evaluations against leaf miner, *T. absoluta* were conducted on 40 leaflets (Gonzalez-Cabrera *et al*., 2011) the control treatment was sprayed only with water were randomly collected from each plot before spraying as well as 1, 3, 5, 7, 10 and 14 days after spraying. The outer plants were never sampled in order to avoid border effects. Alive and death larvae were counted using a binocular microscope. Eggs and tunnels per 40 leaflets were counted from each plot.

The percentages of infestation reduction were calculated according to Henderson and Tilton's equation (1955).

Table 1. Insecticides, essential oil, mineral oil and binary mixtures as control agents used in the study.

Trade name	**Common name**	**Rate / 10 liter water**
Coragen 20% SC	Chlorantraniliprole	2cm / 25cm mineral oil 3cm/ 25cm mineral oil 4cm/ 25cm mineral oil
Voliam Flexi 40% WG	Thiamethoxam20%– Chlorantraniliprole10%	2cm / 25cm mineral oil 3cm/ 25cm mineral oil 4cm/ 25cm mineral oil
KZ oil EC 95%	mineral oil	25cm
Garlic oil	Garlic oil	20cm / 25cm mineral oil 30cm/ 25cm mineral oil 40cm/ 25cm mineral oil
Dill oil	Dill oil	20cm / 25cm mineral oil 30cm/ 25cm mineral oil 40cm/ 25cm mineral oil
Control plants	which were sprayed with the tap water.	

RESULTS AND DISCUSSION

Number and Duration of Generations of *T. absoluta* Infesting tomato, *Lycopersicon esculentum* (Mill.) under Felid Conditions:

Results in Fig. (1), revealed that, *T. absoluta*larvae had three seasonal generations during 2017 season, the first generation was occurred between Mid-March to early- April lasted about 35 days, the second generation was occurred between mid-Apriltoearly - May and lasted also about 28 days and the third generation was occurred between early - May to early June. Data revealed that in Fig. (2), *T. absoluta* larvae had three generations in 2018 season, the first generation was occurred from Mid-March to Mid- April and lasted about 43 days. The second generation was occurred between late- April to early-May and lasted about 21 days and the third generation was occurred early-May to early-June and lasted about 28 days,(Table,2)

These results were in line with those obtained by Cherif A, Mansour R, Grissa-Lebdi K. 2013, Ibrahim*et al*., 2016, Cherif A, Mansour R, Grissa-Lebdi K. 2017.

Table (2): Approximated numbers and duration of seasonal generations of *T. absoluta* larvae on tomato at Moshothor, Qalubiya Governorate during 2017 and 2018 seasons.

No. of Generation	2017			2018		
	Approximated date of occurrence		Duration	Approximated date of occurrence		Duration
	From	To	in days	From	To	in days
1st	15, March	6, April	35 days	15, March	13, April	43 days
2nd	13, April.	3, May	28 days	20, April.	3, May	21 days
3rd	10, May	1, June	28 days	10, May	1, June	28 days

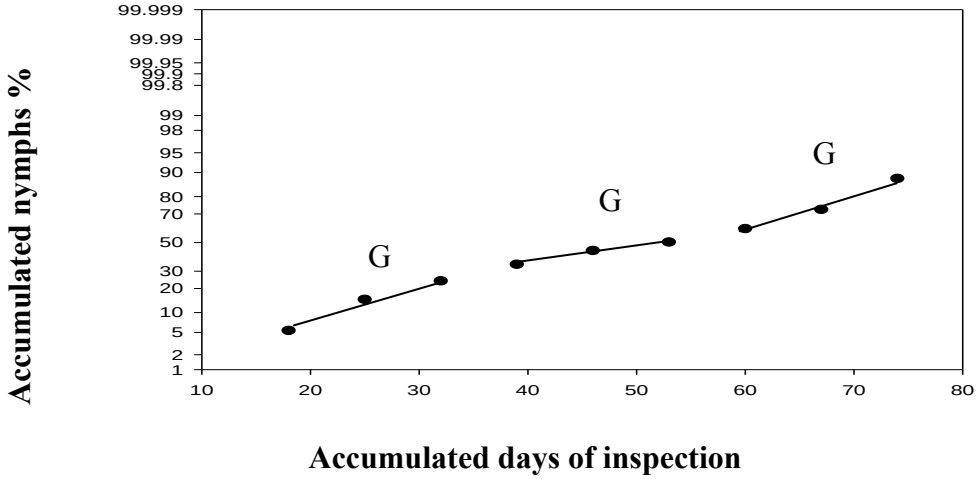

Fig. (1) The sequence of annual generations of *T. absoluta* larvae on tomato at Moshothor, Qalubiya Governorate during 2017

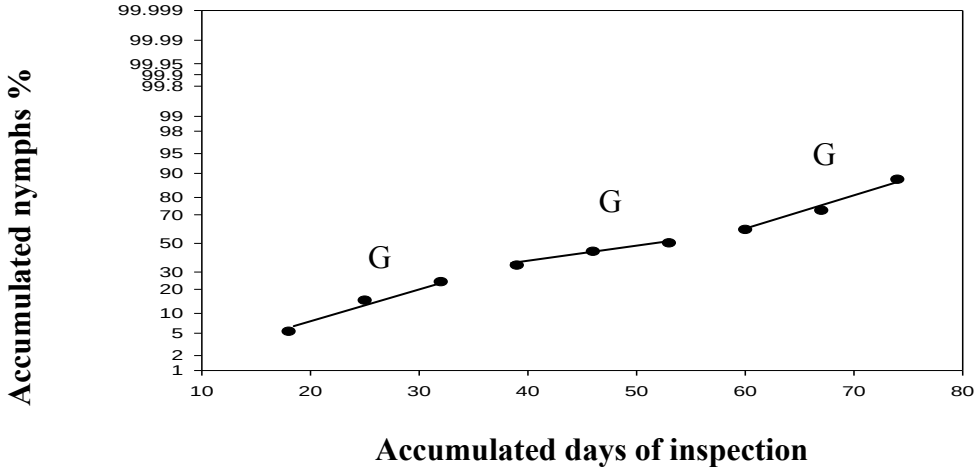

Fig. (2) The sequence of annual generations of *T. absoluta* larvae on tomato at Moshothor, Qalubiya Governorate during 2018.season.

The Efficiency of Control Agents on *T. absoluta* Larvae:-

Gradual reduction percentages of tomato leafminer *T. absoluta* numbers as a result of chemical pesticide, essential aromatic oils (Garlic, Dill) , mineral oil alone and in binary mixtures treatments were recorded in both seasons 2017- 2018 (Tables 3). Data indicated significant differences between the thirteen compounds where F.

value = 6.55 and L.S.D = 4.98%. These compounds could be divided five groups.The first group contained on 4cm Coragen 20% SC / 25cm mineral oil, 3cm Coragen 20% SC / 25cm mineral oil, 4cm Voliam Flexi 40% WG / 25cm mineral oil and 40cm Dill oil / 25cm mineral oilshowed highly mortality 88.5%, 86.9%, 85.4and 83.9, respectively. The second group contained 3cm Voliam Flexi 40% WG / 25cm and 2cm Coragen 20% SC / 25cm mineral oil, mineral oil showed moderate effect 81.6% and 79.2%, respectively. The third group contained 30cm Dill oil / 25cm mineral oil, 2cm Voliam Flexi 40% WG / 25cmand 40cm Garlic oil / 25cm mineral oil showed 76.8%, 76.0% and 75.2%, respectively.the fourth group contained 20cm Dill oil / 25cm mineral oil and 30 Garlic oil / 25cm mineral oil showed 73.3% and 72.3%, respectively. the fifth group contained 20cm Garlic oil / 25cm mineral oil showed low effects of 61.7%.

Table 3. Mean reduction percentage of *T. absoluta* alive larvae/ leaf on tomato plants at Qaha, Qalubiya Governorate during 2017 and 2018.

Treatments	No. Nymph Per Treatments	Initial Kill	Residual effect treatments					Average %
		After 24 hours	3 Days	5 Days	7 Days	10 Days	14 Days	
2cm Coragen 20% SC / 25cm mineral oil	75	61.2	74	89.5	92.8	82.0	80.2	79.2b
3cm Coragen 20% SC / 25cm mineral oil	89	65.2	75.2	94	100	100	85	86.9a
4cm Coragen 20% SC / 25cm mineral oil	80	73.8	81.8	95.8	100	100	88	88.5a
2cm Voliam Flexi 40% WG / 25cm mineral oil	84	53.2	65	74.6	88.4	85.8	81	76.0c
3cm Voliam Flexi 40% WG / 25cm mineral oil	88	55.2	70.2	78.2	91.5	100	88	81.6b
4cm Voliam Flexi 40% WG / 25cm mineral oil	78	62.2	78.8	89	100	100	90	85.4a
20cm Garlic oil / 25cm mineral oil	88	44.8	52.4	76.4	82.2	77.2	71.4	61.7e
30cm Garlic oil / 25cm mineral oil	85	45.2	55	75.8	85.4	80.2	79.2	72.3d
40cm Garlic oil / 25cm mineral oil	79	47.2	57.4	77.2	85.8	91.5	88.3	75.2c
20cm Dill oil / 25cm mineral oil	87	43.6	55.4	72.4	93	80	81.6	73.3d
30cm Dill oil / 25cm mineral oil	77	50.2	60	67.4	94.8	94.9	93.1	76.8c
40cm Dill oil l / 25cm mineral oil	79	51.3	79	92	96.8	100	89	83.9a
Control (water)	89	--	--	--	--	--	--	--

F value = 6 .55* L..S.D. = 4.98

Means followed by the same letters are not significantly different according to the $LSD_{0.05}$.

Data in (Tables 4) indicated the gradual reduction percentages of leafminer tomato *T. absoluta* numbers as a result of chemical pesticide, essential aromatic oils (Garlic, Dill) , mineral oil alone and in binary mixtures treatments and control (mineral oil) in both seasons 2017- 2018. Data showed highly significant differences between the thirteen compounds where F. value = 54.59 and L.S.D = 2.00%. These compounds could be divided into seven groups. The first group contained on 4cm Coragen 20% SC / 25cm mineral oil and 3cm Coragen 20% SC / 25cm mineral oil showed highly mortality 88.5%, 86.9%, respectively. The second group was contained 4cm Voliam Flexi 40% WG / 25cm mineral oil and 40cm Dill oil / 25cm mineral oilrecorded 85.4 and 83.9, respectively. The third group that was contained3cmVoliam Flexi 40% WG / 25cm and 2cm Coragen 20% SC / 25cm mineral oil, showed moderate effect 81.6% and 79.2%, respectively. The fourth group contained30cm Dill oil / 25cm mineral oil,2cm Voliam Flexi 40% WG / 25cm and 40cm Garlic oil / 25cm mineral oil showed 76.8%, 76.0% and 75.2%, respectively. The fifth group contained 20cm Dill oil / 25cm mineral oil and 30 Garlic oil / 25cm mineral oil showed 73.3% and 72.3%, respectively. The sixth groupwas25cm mineral oil recorded 68.8% and the seventh was 20cm Garlic oil / 25cm mineral oil showed low effects of 61.7%.

Table 4. Mean reduction percentage of *T. absoluta* alive larvae/ leaf on tomato plants at Qaha, Qalubiya Governorate during 2017 and 2018.

Treatments	No. Nymph Per Treatments	Initial Kill	Residual effect treatments					Average %
		After 24 hours	3 Days	5 Days	7 Days	10 Days	14 Days	
2cmCoragen 20% SC / 25cm mineral oil	75	61.2	74	89.5	92.8	82.0	80.2	79.2c
3cmCoragen 20% SC / 25cm mineral oil	89	65.2	75.2	94	100	100	85	86.9a
4cmCoragen 20% SC / 25cm mineral oil	80	73.8	81.8	95.8	100	100	88	88.5a
2cm Voliam Flexi 40% WG / 25cm mineral oil	84	53.2	65	74.6	88.4	85.8	81	76.0d
3cm Voliam Flexi 40% WG / 25cm mineral oil	88	55.2	70.2	78.2	91.5	100	88	81.6c
4cm Voliam Flexi 40% WG / 25cm mineral oil	78	62.2	78.8	89	100	100	90	85.4b
20cm Garlic oil / 25cm mineral oil	88	44.8	52.4	76.4	82.2	77.2	71.4	61.7g
30cm Garlic oil / 25cm mineral oil	85	45.2	55	75.8	85.4	80.2	79.2	72.3e
40cm Garlic oil / 25cm mineral oil	79	47.2	57.4	77.2	85.8	91.5	88.3	75.2d
20cm Dill oil / 25cm mineral oil	87	43.6	55.4	72.4	93	80	81.6	73.3e
30cm Dill oil / 25cm mineral oil	77	50.2	60	67.4	94.8	94.9	93.1	76.8d
40cm Dill oil l / 25cm mineral oil	79	51.3	79	92	96.8	100	89	83.9b
25cm mineral oil (control)	80	47.5	51.8	63.2	72	88	79	68.8f

F value = 54 .59**L..S.D. = 2.00

Means followed by the same letters are not significantly different according to the $LSD_{0.05}$.

Conclusion:

Application of such chemical insecticides and binary mixtures with mineral oil or Dill oil binary mixtures with mineral oil produce had highly significant effect on *T. absoluta* infesting tomato crop. The insecticide binary mixtures with mineral oil have effect on pest population whereas decreased mean number population of pest. The insecticide binary mixtures with mineral oil were the most efficiency method compared to control (without treatment or mineral oil alone).

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ARABIC SUMMERY

بعض التطبيقات الحقلية لمكافحة التوتا ابسيلوتا *Tuta absoluta* Meyrick (Lepidoptera,Gelechiidae) فى مصر

بدران عبد الفتاح بدران، منى نصر وهبه ، منى ابراهيم عمار
معهد بحوث وقاية النباتات- مركز البحوث الزراعية- الدقى- الجيزة- مصر

صانعة انفاق أوراق الطماطم أو حشرة توتا ابسولوتا تعتبر واحدة من الآفات الرئيسية التى تصيب الطماطم في مصر .المواد الكيميائية والزيوت العطرية هي الطريقة الرئيسية للتحكم بها. ومع ذلك ، تهدف الدراسة إلى تقييم المبيدات الكيميائية ، والزيوت العطرية (الثوم والشبت) والزيوت المعدنية بمفردها و على هيئه مخاليط ثنائيه ، لتحديد تأثيرها على كثافة تعداد آفة حشرة الطماطم *Tuta absoluta* بالإضافة إلى آثارها على انتاجية الطماطم .وأظهرت النتائج أنه خلال الموسمين 2017 و 2108 سجلت *T. absoluta* ثلاثة أجيال في كلا الموسمين .عند استخدام مبيدات الكيميائية ، الزيوت العطرية الأساسية (الثوم والشبت) والزيوت المعدنية وحدها و على هيئه مخاليط ثنائيه ، توجد اختلافات معنوية عالية بين المركبات الثلاثة عشر. وكانت افضلهم فى الاستخدا م 4(سم كوراجين 20 ٪ + 25سم زيت معدني ، 3سم كوراجين 20 ٪ +25 سم زيت معدني ، 4 سم فوليام فليكس 40٪ +25 سم زيت معدني و 40 سم زيت الشبت + 25سم زيت معدني تظهر نسبة موت عالية عند استخدام زيت الثوم 20 سم + 25 سم زيت معدني).