Allelopathic potential of Myrtle, *Myrtus communis* L. Upon some crops

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Abstract:

Many experiments were achieved to determine the allelopathic potential of the plant Myrtle parts in which it may affects other plants, like: volatile substances which released from the Myrtle leaves , and its effect examined on the germination (GE) and growth (GR) of the selected crops ; Chickpea (C) , Wheat(W) , and Lentil (L)., the aqueous extract of the leaf and the root of the plant examined to test its effect on the (GE) and (GR) of the selected crops ; (C) , (W) , and (L)., also plant residue of (M) and its effect tested on the (GE) and (GR) of the selected crops ; (C) , (W) , and (L) . Experiments proceeded on Spring 2007 in the greenhouse conditions , and main results which found were that; the effect of the volatile substances released from the Myrtle plant was so great and reached significant levels in all cases and with all tested crops .Whereas, the effect of the other pathways were only in an obvious states and only in the following cases reached a significant levels which were; - the case of the effect of the plant residue on the(GR) of root , shoot , and seedlings of the selected crops ; (C),(W) ,and (L) .-the case of the effect of the plant residue on the (GR) of (W) seeds. The case of the effect of the aqueous extract of the root of the Myrtle plant on the (GE) of the (C) seeds β- And finally, the case of the effect of the aqueous extract of the root on the (GR) of the root, shoot, and the seedlings of (L).

Key words: Myrtle, allelopathy, volatile substances, germination, aqueous plant extract, plant residue, crops.

Introduction:

Allelopathy is often an important ecological process in regulating plant population in agricultural ecosystems [1]. Today, research in allelopathy is conducted by weed scientists, crop scientists, plant ecologists, microbial ecologists, community ecologists, agroecologists and natural products chemists, amongst others, often using an interdisciplinary approach. The number of multi-author books on the subject has increased in recent years [2, 3]. Evidence for allelopathic interactions in nature by plants with allelopathic potential which play their rule by many ways; the plant may release allelopathic substances from their roots as aqueous leaching from the residual dead parts in the soil, or from the leaves as volatile substances [1, 4 and 5]. Some plants with allelopathic effect (donor) may affect the other neighbor plants (receiver) by releasing volatile substances, and essential, oils from their leaves [6] like the leaves of *Eukalyptus* trees affecting surrounding plants [7] , and like many species of *Brassica* do upon the studied species plants like , wheat and lettuce [8] .

It is necessary to approach many researches and studies in this field about the different plants species to test their allelopathic potential , so that

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finally facilitate to prepare long lists of the plants with their allelopathic force, which then might used as biological herbicides instead of the industrial , chemical man- made herbicides (4),which affected not only the useful untarged companion plants, but, also the disadvantages in using such herbicides such as; long lasting (undegradable), accumulation, and it may form long –term pollutant in the soil [9 and 10].The goal of this study was to record the strong effect of Myrtle plant *Myrtus commnis* L. in which expected to affect some selected species, myrtle plant contains an essential oil with several phloroglucinols , they are considered responsible for the plant's antibacterial and anti-inflammatory properties, as well as polyphones , such as flavonoids, ursolic acid , and several volatile compounds. Phytochemical studies on myrtaceaeous plants have led to investigations into the biological properties of tannins and related polyphenolic compounds isolated from the leaves of *M. communis* [11]. Also the leaves release volatile compounds like methyl jasmonate and alpha pinene and non volatile like β- cumaric acid [12].

Materials and Methods:

Selection of Plant Species:

Three crops were chosen, because of their economic importance in Iraq, which they enter the Iraqi individual meal; these three crops are widely planted in Iraqi agriculture fields. The three crops are: *Triticum aestivum* L. which belong to the poaceae family, *Cicer arietinum* L.which belong to family Leguminosae, which its origin is from southern Europe, now a day planted in Arabian area. And *Lens culinaris* Medic.,which belong to the Fabaceae family, it considered as most ancient cereal which was used as foodstuff by the man , because of its high percentage of protein 29% [13].

Myrtle or Yas, *Myrtus cmmunis* L. had been used as a donor of the allelochemical potential which is an evergreen shrub distributed throughout Mediterranean ecosystems. In addition to its use as an herb and culinary spice, *M. communis* has been employed in folk medicinal practices as an antiseptic, anti-inflammatory agent and in the treatment of diabetes mellitus [11].The plant is beautiful even aromatic shrub and considered medicinal especially the leaves which possess a stringent properties and is given in cerebral affections, epilepsy and pulmonary disorders and in disease of stomach and liver. The so-called myrtle oil which obtained by steam distillation of the leaves is used in soap odor and it possesses disinfectant; anti respiratory and tannin and resin which used in flavoring wines and foods [14]. Also it used as fences plant around the parks and gardens in many Iraqi cities .The plant were collected from the garden of Science Education college in Salahaddin University which used as fence around the passages and paths .

Effects of volatile substances released from Myrtle leaves on germination of selected crop seeds;

The method of Oleszek, [8] was used, the system prepared as below:

Fresh leaves of Myrtle were collected on April, 2007. The leaves were chopped manually and 30 g. was weighted and placed in a watch glass and placed on a plastic cylinder , then the two placed in the middle of ,the bottom of the jar covered with a filter paper , ten seeds of the tested crop and then the paper was wetted by adding 10 ml of distilled water finally the jar was covered with peace of transparent glass and placed in the greenhouse in which the temperature was 25^0C, with

relative humidity 70% and day light tendency,(Figure 1).
The control established in the same manner, without the chopping leaves. This was done to each crop seed and with three replications to each crop and so done to the control of each crop (Taken in consider to assuring the viability of the seeds by proceeding a small bioassay of viability test).

The experiment was carried out for 7 days. Then the germination of each crop seeds was counted and the results were analyzed statistically using statistical analysis of T-test, under the level of 0.05, [15, 16 and 4]. All other experiments were compared with their controls.

Effect of volatile substances released from Myrtle leaves, on growth of selected crops seedlings:

The germinated seeds were reduced from the previous experiment jars to 3 seedlings in each one randomly and planted in plastic pots with capacity of 250 g which contains,200 g of clean, washed with commercial Clorox , and dry sand in each . Then watered with 50 milliliters of distilled water in each pot and placed in the controlled condition for further 8 weeks. At the end of the experiment the length of the seedlings, shoots and the roots were measured. Then the results were analyzed statically.

Effect of soil around roots of Myrtle on seed germination of selected crops:

The method used in this experiment was the method of Al- Saadawi and Rubeae, [17]. We took the moist soil around the root of the donor plant in the field and placed 300g In each non- perforated pot with capacity of 500 milliliters and ten seeds were planted of each crop seed , with five replications to each crop , watered with a appropriate amount of distilled water and the pots were covered with glassy Petri- dish to minimize evaporation and to protect from dryness .

All pots of the control were treated in a similar manner as in treatment pots with exception of the soil which here replaced with a same characteristic soil and same habitat but, it collected far from the myrtle rhizospheres (bare land which were neither contaminated with pesticides nor provided with fertilizers).

At the end of the experiment the germination was recorded and the results were analyzed statistically [15].

Effect of residue of Myrtle on growth of selected crop seedlings:

In the end of the previous experiment the seedlings in each pot were reduced to three seedlings in each randomly, and then the experiment was conducted for further eight weeks in the same controlled condition. The pots were watered as necessary with distilled water.

In the end of the experiment the plants were removed from the pots cleaned and washed with tap water then their lengths were measured separately with measuring scale, then the results were analyzed statistically.

Effect of aqueous extract of Myrtle plant on selected crops:

The method used in this experiment was that of Al-Saadawi et al., [16].
A suitable amount of the leaves and the roots were collected freshly and separately, and then these were washed and cleaned under tap water separately. Then these were scattered on a sheath of nylon in room temperature and left to dry, then crushed with an electric homogenizer and turned to powder separately, 30 g was weighted from each part and placed in a thimble of the soxhlet apparatus which was already containing 300 mL of 70% ethanol as a

solvent and the system was heated on a mantle heater on 70 C^o. temperature for 24 h. Then the solvent was evaporated with rotary evaporator (model; Heidolph-borta4000/Germany) to dryness, and then the remaining substances were dissolved in 300 mL distilled water. For control treatment, all steps were repeated with the exception of the plant powder which was excluded and the test was completed with empty thimble apparatus for control treatment.

After completing steps above, 1% concentration for each part of the donor plant was prepared by the dilution of the 300 mL aqueous extract to the demanded concentration which was 1% [4]. And then the extraction was ready to be use in the following experiments.

Effect of aqueous extract of Myrtle on germination of selected crop seeds:

We used here the clean sand bioassay technique, as an inert substrate, using Hoagland's solution ¼ strength as rich nutrient [18]. In the present study 20 mL of the certain extract with 30 mL of Hoagland solution to each non- perforated pot which contain 200 gm of clean sand was used, then we planted 10 seeds of each tested plant per pot with five replications to each crop. For control treatment only 50 mL of Hoagland solution was added (without the extract). Pots were covered with Petri-dishes which are fit to the top to minimized evaporation, and protect the seedlings from dryness, then the pots were scattered randomly in the green house under the possible controlled conditions for 7 days. At the end of the experiment the germination was measured and the results were analyzed statistically.

Effect of aqueous extract of Myrtle plant on growth of selected crop seedlings;

At the end of the previous experiment the plant were reduced in each pot to three seedlings randomly, and the experiment was continued for further 8 weeks. The pots were watered with enough of Hoagland's solution to prevent them from dryness.

The seedlings were cleaned and washed with tap water, then the length of each seedling was measured with measuring scale, then the results were analyzed statistically as the rest experiments.

Results and Discussion:

Effect of volatile substances released from the leaves of Myrtle plant on germination of seeds and growth of selected crop seedlings;

The results show that the volatile substances released from the Myrtle leaves have a significant effect on the germination of the selected crops in all treatments and all seeds were inhibited severely comparing with the control seeds (Table, 1). The great effect was on the germination of the lentil seeds , and then on the germination of Chick pea seeds , and finally the effect on the wheat seeds were less affected , which the inhibition percentages were ; 30% , 28% , and 22.6% respectively .

All effects were significant in the level of 0.05% by the T test analysis. The experiments revealed that the volatile substances have a great effect on growth of the selected crops shown clearly Table 2.

The length measuring as a parameter of growth showed significant inhibition of the shoot, root, and whole plants length. The inhibition percentage of the seedlings were respectively on the seedling of the Chick pea ,Wheat , and Lentil were : 79.71% , 74.24% , and 71.07%, respectively.

All these effects showed significant differences with their

controls by using T test at the level of 0.05. This kind of results and inhibitory capacity of our study plant deal with many other studies on other plants in which such inhibitory effect well known and even well documented [8] studied the effect of the volatile substances released from the leaves of *Brassica nigra* L. which strongly inhibited the germination and growth of *Lactuca sativa* L. and *Echinocloa crusgali* L.plants. Bell and Muller in 1973 also get similar results when they studied the failure of the seed germination then growth suppression of *Avena fatua* L. when planted near mustard plant [1].

Also these results proved that the leaves is the main pathway by which Myrtle affect the other pants by the allelochemical substances which identified to be ten polyphenolic compounds, including four hydrolysable tannins, two related polyphenols, and four flavonoid glycosides [11].

Effect of plant residue of Myrtle on germination and growth of selected crops:

The seeds of the selected crops affected by some kind of inhibitors gained from the mixture of plant residue added to the soil, and the evidence on this statement is what found in Table 3. In which the percentages of the germination of all crop seeds were so low that in two crops; Chickpea and Wheat reached significant level using statistical analysis of T-test, under the level of 0.05, the inhibition percentages were respectively; 25.6% in Chickpea and 22.09% in Wheat seeds. But in Lentil crop the inhibition never reached significant levels, only remained in obvious affection; 4.71%. (Table, 3).

The least affected crop was Chick pea seedlings which only the inhibition of the growth was in an obvious level and the length mean of the seedling inhibition percentage reached 6.75%, when compared with control seedlings.

The effect of the two other crops were significant and the inhibition were significant in the length of the seedlings as whole , as well as the length of the shoots and of the roots of the selected crops ; which were significant effect in the wheat seedlings and its root and shoot as well which was 27.44% .The lentil faced significant effect too, in which the inhibition percentage was reached 11.93% ,when compared with control plants (Table , 4) .

These results were very reasonable when compared with other new researches such as what was found by [19], when he studied the effect of the plant residues of sunflower, corn, soy bean and weeds like *Echinocloa colonum, Amaranthus reflexus* and *Portulaca oleracea* ,the highest of sunflower straw caused a significant decreases in the germination percentage , the stem diameter ,the value of the leave area index ,and the studied plant heights.

In another study, Ahmed, [13], noticed same effects of the straw of wheat *Triticum aestivu*m L. and lentle, *Lens culinaris* Medic. When studied the germination percentage and other parameters of the two crops.

Effect of aqueous extract of root, and shoot of Myrtle on germination and growth of
Selected crops:

The aqueous extract of the root was not effect able to the germination of the chick pea and the wheat seeds absolutely, as it showed in Table 5. But, this solution had a clear effect on the lentil seeds which was 15.79%, while the aqueous extract of the shoot have a significant effect on the germination on the Chick pea seeds and it reached 78.46%. The other crop

seeds are not affected by the extract. As we noticed, instead of inhibitory effects of the aqueous extract upon the germination of the crop seeds we found adverse and even stimulate effects (The amount of the stimulation excluded from the results because of the main aim of the study), and these stimulatory effects are common among the plants such as which found by [13], when studied wheat and lentil crops.

The aqueous extract of the roots of Myrtle had strong inhibition suppression and it reached significant levels only in the average of the shoot length and seedlings length of the Lentil crop which was 20.2, and 24.08 cm respectively, and the inhibition percentage reached 23.31%. While, the root of this crop not significantly affected at all.

There were no significant effect on the root , shoot , and seedlings of the crop chick pea which only the effect of the extract was notable on the root , shoot and the seedlings of the chick pea lengths,(6.5 ,25.4 , and 31.9 cm), respectively. The inhibition percentage reached 15.94% when compared with the control seedlings of chick pea.

The effect of the extract of the myrtle on the wheat seedlings were just in an observed state and do not reached significant levels, as expected, which the effect of the root extract the length of the root , shoot , and the seedlings were (6.50 , 22.10 , 28.60 cm respectively). The inhibition percentage on the whole seedlings length when compared with the length of the control seedlings was only 1.72%.

Also the effect of the shoot extract of Myrtle was observed on the root ,shoot , and the seedling length of the wheat crop which were : (6.55 , 15.85 , and 22.4cm. respectively) , and the inhibition percentage reached 22.13% when the seedling of the treatment compared with the seedlings length of the control.

We found in the present study, little effect of the aqueous extract and such inhibitory effects upon growth of the crops is common and observed also by many other investigators [20, 21 and 22].

Table (1): Effects of the volatile substances released from the Myrtle leaves on germination of selected crop seeds[a]:

Crop Types	Treatments	Percentage of germination	Percentage of inhibition
Chickpea	Control	96.70	0.00
	treatment	72.00[b]	28.00
Lentil	control	100.00	0.00
	treatment	70.00 [b]	30.00
Wheat	control	96.70	0.00
	treatment	77.40[b]	22.60

a: Each number in the table is the average of three replication , and each replication contain (10) seeds .
b: This has significant differences comparing with control Under the level of 0.05 using t. test.

Table (2): Effects of the volatile substances released from the Myrtle leaves, on growth of selected crop seedlings [a] :

Crop Seedling	Treatment	Average of the length in cm. shoot____root_____seedling	Percentage inhibition
Chickpea	control	6.70 5.08 11.78	0.00
	treatment	2.00[b] 2.39[b] 4.39[b]	79.71
Lintel	control	12.01 6.00 18.01	0.00
	treatment	2.01[b] 3.20[b] 5.21[b]	71.07
Wheat	control	13.55 14.01 27.50	0.00
	treatment	4.20 [b] 2.90[b] 7.10[b]	74.24

a: Each number in the table is the average of three replication , and each replicate contain three plants .
b: This has significant differences with the control under the level of 0.05 by using t. test .

Table (3): Effects of the plant residue of Myrtle on germination of seed of selected crops [a]:

Selected seed Crops	treatment	Percentage of germination	percentage of inhibition
Chickpea	control	90.03	0.00
	treated seed	67.00 [b]	25.60
Lentil	control	84.00	0.00
	treated seed	81.00	4.71
Wheat	control	85.00	0.00
	treated seed	66.22	22.09

a: Each number in the table is the average of three replication , and each replicate contain (10) seeds.
b: This has significant differences with the control under the level of 0.05 by using t. test.

Table (4): Effects of the plant residue of Myrtle on growth of selected crops [a]

Crop type	treatment	Average of the length in cm. shoot__+__root_____seedling			Percentage of inhibition
Chickpea	control	20.90	9.02	29.92	0.00
	treatment	17.50	10.40	27.90	6.75
Lentil	control	25.25	8.02	33.27	0.00
	treatment	24.10[b]	5.20[b]	29.30[b]	11.93
Wheat	control	20.52	9.54	30.06	0.00
	treatment	14.64[b]	7.02[b]	21.66[b]	27.44

a: Each number in the table is the average of three replication , and each replicate contain three plants .
b: This has significant differences with the control under the level of 0.05 by using t. test .

Table (5): Effects of the aqueous extract of root and leaf of Myrtle on germination of selected crop seeds[a]:

Crop type	treatment	percentage of germination	percentage of inhibition
Chickpea	control	65.00	0.00
	root exudate	80.60	0.00
	leaf exudate	14.02[b]	78.46
Lentil	control	95.20	0.00
	root exudate	80.00	15.79
	leaf exudate	97.50	0.00
Wheat	control	55.10	0.00
	root exudate	90.00	0.00
	Leaf exudate	82.65	0.00

a: Each number in the table is the average of three replications , and each replicate contain (10) seeds .
b: There is significant differences comparing with the control , under the level of 0.05 using t. test .

Table (6): Effects of root and leaf extract of Myrtle plant on growth of selected crops[a]:

Crop plant	Type of Extract	Selected plant parts	Mean of plant (in cm)	Percentage Of inhibition
Chickpea	Control	root	6.28	
		shoot	31.67	
		seedling	37.95	0.00
	Root extract	root	9.80	
		shoot	33.50	
		seedling	42.50	0.00
	Leaf extract	root	6.5	
		shoot	25.40	
		seedling	31.90	15.94
Lentil	Control	root	5.50	
		shoot	25.90	
		seedling	31.40	0.00
	Root extract	root	3.88	
		shoot	20.20[b]	
		seedling	24.08[b]	23.31
	Leaf extract	root	4.55	
		shoot	25.00	
		seedling	29.55	5.9
Wheat	Control	root	8.01	
		shoot	20.90	
		seedling	28 .91	0.00
	Root extract	root	6.50	
		shoot	22.10	
		seedling	28.60	1.72
	Leaf extract	root	6.55	
		shoot	15.85	
		seedling	22.40	22.18

a: Each number in the table is mean of (9) replicates
b: It differ from the control plants significantly by t. test at the degree of freedom 0.05 .

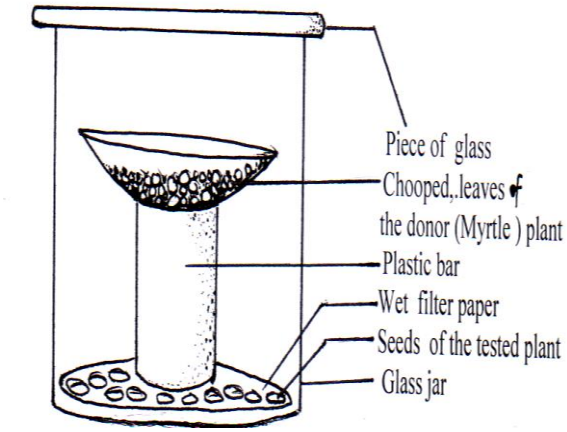

Fig.1 .Schematic representation of germination system (8).

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التأثير الاليلوباثي لنبات الياس ضد بعض المحاصيل

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الخلاصة:

اجريت عدة تجارب لتحديد الجهد الاليلوباثي لنبات الياس التي تؤثر بها على انبات بذور ونمو بادرات المحاصيل المختبرة (الحمص والعدس والحنطة)، وبمسالكها المختلفة مثل مسلك المواد المتطايرة من اوراق الياس ودراسة تأثيراتها على نمو وانبات المحاصيل المختبرة.وكذلك دراسة مسلك المستخلصات المائية (الجذرية والخضرية) .للنبات وتأثيراتها على انبات و نمو المحاصيل المختبرة .واخيرا ،دراسة تأثير المخلفات النباتية للياس وملاحظة تأثيراتها على النباتات المختبرة ،وانجز البحث في ظروف البيت الزجاجي في ربيع 2007 و اهم نتائج البحث هي تأثيرات المواد المتطايرة والتي كانت جوهرية على انبات ونمو النباتات المختبرة كافة، وكذلك تاثيرات المسالك الاخرى كانت ملحوظة عدى ،حالة المخلفات النباتية على نمو الجذور والسيقان للحمص والحنطة وفي حالة المستخلصات المائية لجذور الياس على انبات الحمص وأخيرا ،في حالة المستخلصات المائية للجذور على نمو الجذور والمجموعة الخضرية لمحصول العدس فقط. والتي في هذه الحالات فقط وصلت الى حدود التأثيرات الجوهرية .