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EFFECT OF SOME PLANT EXTRACTS ON MORPHOLOGICAL AND ANATOMICAL CHARACTERS OF *Corchorus olitorius* L., IN RELATION TO ITS RESISTANCE TO DODDER INFECTION

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ABSTRACT

Aqueous plant extracts of ajowan, belladonna and canna were applied to study their effects on the growth of dodder (*Cuscuta campestris* Yunck) infecting jew's mallow (*Corchorus olitorius* L) , to find out whether these effects would specify the nature of resistance to dodder (mechanical or chemical). The results of dodder growth showed a gradual corresponding inhibition by increasing the concentrations of the extract source.The highest positive results were achieved by ajowan extract, followed by belladonna , while canna was the lowest .On the contrary , the components of the vegetative yield (fresh and dry weights) of jew's mallow were increased by decreasing the concentration as the lowest extract concentration of either ajowan or belladonna gave the highest vegetative yield components. Treatment of dodder seeds with jew's mallow extract showed no effect on germination indicating the high susceptibility of jew's mallow to dodder infection while, the chemical resistance was clearly observed in treatment with ajowan extract. The disadvantage of the high concentration of ajowan was that it decreased the vegetative growth and the stem diameter of jew's mallow. The anatomical study revealed that, this was due to the decrease in thickness of different tissues, although the parasite failed completely to penetrate the epidermis.The lowest concentration gave a reverse effect by increasing thickness of the vascular system although it gave 86.5% resistance.

Keywords: Corchorus olitorius, jew's mallow, Cuscuta campestris, dodder, plant extract, morphology, anatomy, resistance, susceptibility.

INTRODUCTION

The genus *Cuscuta* (dodder) belongs to family Convolvulaceae, and contains approximately 150 species (Severova,1991), all are obligate parasites that attack the stems of the host plants. They infect numerous wild plants, and also a wide range of field crops and vegetables i.e; alfalfa, Egyptian clover, flax, sugar beet, tomato, potato, jew's mallow, carrot, onion and asparagus (Dawson, 1987).

Jew's mallow (*Corchorous olitorius* L.) is an annual plant, belongs to family Tiliaceae and one of the favourable vegetables in Egypt, rich in vitamin A, calcium and magnesium (Khalafallah *et. al.*,1990). It is planted for local consumption and export, as its fresh or dry leaves are cooked.

Extracts of some plants are applied for inducing resistance against many parasites such as; schistosoma, fungus, bacteria and weed plants(specially, *Cascuta spp.*).

Regarding schistosoma, the aqueous extract of *Canna indica* inhibited *Biomphalaria alexandrina* growth due to the presence of saponins (Mahran *et.al.*, 1974).

As to the fungus and bacteria, the seedlings extract of ajowan (*Carum copticum*) caused 100 % inhibition of spore germination of *Botrytis cinerea* and *Glomerella cingulata* (Kalpana *et.al.*,1986). Meanwhile, essential oil of ajowan seeds showed degrees of growth inhibition against *Aspergillus niger* and *Bacillus cereus,* due to the presence of phenol and terpenoid compounds (Meena and Sethi ,1994).

Regarding the weed plants, seed germination of milk weedvine (*Morrenia odorata*) was inhibited by using the extract of *Lantana camara* leaves(containing phenols) (Nagi and Megh , 1984).Moreover, the extract of *Atropa belladonna* leaves and *Datura stramonium* seeds inhibited seed germination as well as seedling growth of many weed species due to alkaloid compounds (Putnam , 1988).

Application of aqueous extracts of many plants against dodder infection revealed that nature of resistance was either chemical or mechanical. Examples of chemical resistance, weed extracts of both *Cynodon dactylon* and *Chenopodium murale* when applied against dodder parasitising on alfalfa at the higher concentrations (50 and 25 g dry matter/100 ml) gave between 96 and 83% control, although the 50% concentration injured the alfalfa foliage, due to phytotoxic agents; phenolic compounds(Habib and Rahman ,1988).

Ali (1996) indicated that aqueous extracts of *Datura stramonium* seeds(contains alkaloids) at 0.5 g/10 ml, *Panicum repens* rhizomes *at* 1.0 g/10 ml and *Lantana camara* leaves at 1.5 g/10 ml (both contain phenols) were effective in controlling attached dodder on berseem clover without injuring the host plant. Using higher concentrations (1.5 g/10 ml) of *D. stramonium* and *P. repens* plants achieved complete parasite control, although injury of 21.6 and 37.2 % to berseem plants occurred. He added that, plants of *Lantana camara* were considerably resistant, as the haustoria failed to reach the vascular tissue of the host plant. This could be due to phenolic compounds. While *Duranta plumieri* was more susceptible as the haustoria penetrated the cortex and reached the vascular tissue..

As to the nature of mechanical resistance to dodder infection, Capderon *et. al.*(1985) stated that, resistance of cotton to dodder is based on the formation of suberized layer of cells from a secondary meristem isolating the haustoria.

Al-Menoufy and Ashton (1991) found that,in *Lycopersicon chmielewskii* and *L. hirsutum* plants, cells of epidermal and cortical tissues, penetrated by dodder haustoria showed a hypertrophic reaction , causing these tissues to burst, forming a barrier. Thus the haustoria failed to reach the vascular tissue of the host plants.

The present research aimed to study:

A) The effect of three types of plant extracts;

1- ajowan (AJ), 2- belladonna (BL) and 3- canna (CN) on:

a- Seed germination and plant growth of dodder

b- Growth of jew's mallow plants infecting with dodder and their resistance percentages to dodder infection.

B) The nature of resistance against dodder infection (chemical or mechanical).

MATERIALS AND METHODS

The present study was carried out in the Experimental Station of the Faculty of Agriculture, Cairo University, Giza, during 2002 and 2003 seasons.

A: Plant material:

Plants and organs selected for extraction were; mature seeds of ajowan (*Carum copticum* L.), mature leaves of belladonna (*Atropa belladonna* L.) and rhizomes of canna (*Canna indica* L.) and stems of squash (*Cucurbita pepo* L.).

Materials used for extraction were procured from the Experimental Station of Medicinal Plants, Faculty of Pharmacy, Cairo University, Giza.

Seeds of jew's mallow (*Corchorus olitorius* L.) and squash (*Cucurbita pepo* L.) as a susceptible and resistant plants, respectively, to dodder infection, were secured from Vegetable Research Division, Agricultural Research Center, Dokki, Giza.

Mature seeds of dodder were collected from plants parasitizing on (*Adhatoda vasica* L.), for both seasons, in the Experimental Station of the Faculty of Agriculture , Cairo University, Giza, (Fig.,1).

B: Extraction procedure:

The dried samples, 25 grams each, were blended in a blender with 100 ml of distilled water, and were left for 24 hours before filtering. The collected extracts were taken as a standard (S); subsequent dilutions were prepared to get different concentrations using distilled water; S_1 = 1/2, S_2 = 1/4 and S_3 = 1/6 of the standard extract.

In addition, stem extracts of jew's mallow, squash and ajowan were prepared using the same technique but without dilution. All extracts were kept in a deep freezer until using.

C: Laboratory experiments:

1- Germination tests for dodder seeds and stem length:

Dodder seeds were dipped for 25 minutes in concentrated sulphuric acid (90%), thoroughly washed with tap water, air dried before using (Graph *et.al.*,1987).

Effects of the aqueous extracts on dodder seed germination were tested in Petri dishes (9 cm in diameter). Twenty five seeds per dish were placed on filter paper moistened with 5 ml/dish of the various concentrations (g/ml) of each aqueous extract. Dishes were covered and incubated at 25±2° C. Germinated seeds were counted after 7 and 10 days of incubation.

Effects of the extracts on early stem elongation of dodder were determined by placing ten germinated seeds between two layers of filter paper in Petri

dishes, then each extract was added (5 ml/dish) through the upper filter paper. The dishes were covered and incubated at 25±2 °C for one week, then shoots were excised at the seed level, and their lengths (cm) and averages were calculated. Shoots fresh weights of 10 seedlings were also recorded.

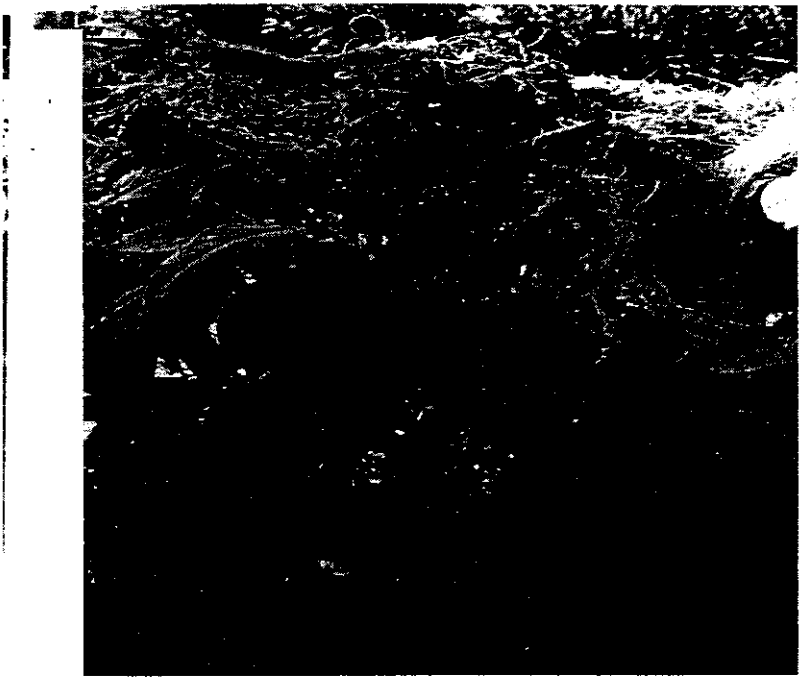


Fig. (1) : Dodder plants parasitizing adhatoda stems

2- Nature of resistance against dodder:

Seeds of dodder were germinated in Petri dishes as stated before,and were moistened with S concentration of the extracts of jew's mallow (JM), squash (SQ) or ajowan (AJ), in addition to the control treatment (distilled water). Germination % and stem length of dodder were determined.

D: Field experiments:

Dodder seeds were scarified as previously mentioned and mixed with jew's mallow seeds at the rate of 1:2, respectively. In June 15th, both seeds were broadcasted in plots (3 replicates /treatment), one square meter in area. After one week, seedlings of both were sprayed with different concentrations of aqueous extracts of ajowan, belladonna and canna. Control plants were sprayed with tap water.

After five weeks from sowing, plant height, fresh and dry weights of jew's mallow shoots were recorded in random sample; (3 replicates of 10 plants). Jew's mallow resistance percent to dodder was determined by

counting the plants which dodder failed to wrap around their stems and could not produce haustoria.

Data were statistically analyzed according to Snedecor and Cochran (1982). Means were compared using the Least Significant Difference (LSD).

E:Anatomical studies:

Samples for anatomical study were taken from stems of jew's mallow and squash plants in the second season, after 35 days from sowing and 3 weeks from spraying with the extracts. Specimens included; 1) Unsprayed jew's mallow plants and were infected with dodder, or 2) Treated with S_1 and S_3 concentrations of ajowan extract as they gave the extreme highest and lowest effect on the morphology of jew's mallow. 3) Uninfected and untreated- jew's mallow as well as squash plants.

Samples of both plants (1 cm long) were taken from the middle of the main stem and were killed and fixed in FAA (10 ml formalin, 5 ml glacial acetic acid, 50 ml ethanol 95% and 35 ml distilled water), dehydrated in a normal butyl alcohol series, embedded in paraffin wax (56-58 °C m.p.). Sections 20 µ thick were cut using a rotary microtome, stained with crystal violet-erythrocin combination and mounted in Canada balsam (Willey, 1971). Slides were microscopically examined and measurements were taken. Averages of 10 readings were calculated and photomicrographs were taken.

RESULTS AND DISCUSSION

I.Dodder growth

1-Plant growth characters:

This involved the effect of different concentrations of ajowan, belladonna and canna extracts on dodder seed germination percent, stem length and shoot fresh weight. Data shown in Table (1) clarified that all studied characters were significantly decreased by using the different types of extracts. Maximum decrease in average of the different concentrations was obtained by using AJ extract, being -69.86, -72.12 and -67.62% compared with the control for germination percent, stem length and shoot fresh weight, respectively. This was followed by BL extract, while CN extract was the lowest.

Comparing the effect of different concentrations within each of the three types of extracts revealed that, the highest concentration (S) recorded the maximum decrease in the three studies characters, being -74.58, -80.59 and -82.39% less than the control, respectively.The interaction effect between the extract type and its concentration proved that, both S and S_1 concentrations of AJ extract, completely suppressed dodder seed germination.

It is evident from these results of the studied characters that, dodder growth was gradually suppressed with increasing the concentration of the three types of extracts. Ajowan extract gave the best results, followed by belladonna, while canna extract was the lowest. This could be attributed to the presence of phenol and terpenoid compounds in ajowan (Meena and

Sethi,1994), alkaloids in belladonna (Putnam, 1988) and saponin compounds in canna (Mahran *et.al.*, 1974). These results are in accordance with those obtained by Nagi and Megh (1984), Putnam (1988) and Ali (1996).

Table (1): Effect of Ajowan, belladonna and canna extracts on seed germination (%), stem length (cm) and fresh weight (mg) of dodder.

Character	Germination (%)				Stem length (cm)				Fresh weight (mg)			
Concnt.	Extract			Mean	Extract			Mean	Extract			Mean
	AJ	BL	CN		AJ	BL	CN		AJ	BL	CN	
S	0.00	10.33	60.33	23.56	0.00	1.44	3.52	1.65	0.000	0.030	0.047	0.025
S_1	0.00	25.00	72.00	32.33	0.00	3.68	5.04	2.91	0.000	0.051	0.074	0.041
S_2	14.33	40.67	79.00	44.67	0.56	4.20	8.00	4.25	0.034	0.055	0.106	0.065
S_3	32.67	58.33	86.33	59.11	2.80	6.72	8.24	5.92	0.053	0.098	0.124	0.091
Control	92.67	92.67	92.67	92.67	8.50	8.50	8.50	8.50	0.142	0.142	0.142	0.142
Mean	27.93	45.40	78.07		2.37	4.91	6.66		0.046	0.075	0.098	
L.S.D (0.05)												
Extract (E)	2.83				1.04				0.011			
Concnt. (C)	3.66				1.34				0.014			
ExC	6.33				2.32				0.024			

2-Nature of resistance against dodder infection:

This was determined by calculating germination percent of dodder seeds treated with the highest concentration of the extracts of jew's mallow (JM), squash (SQ) and ajowan (AJ), as well as stem lengths of dodder seedlings grown in each treatment (Table,2).

As to dodder germination percent, although significant differences were found among the three types of extracts, yet differences between the extracts of JM or SQ and the control treatment were insignificant. Extract of AJ gave full inhibition for dodder seed germination, while JM gave the highest germination percent followed by SQ, being 85 and 72%, respectively, comparing with the control (79%).

Concerning the stem length of seedling, insignificant differences were detected between treatments with the extracts of JM, SQ and the control, while the differences were significant between these treatments and AJ. The tallest dodder seedlings were obtained by using the extract SQ, followed by JM, being 7.40 and 6.19 cm , respectively, comparing with the control (6.63 cm), while no seed germinated in AJ treatment.

Table (2): Effect of jew's mallow, squash and ajowan extracts on seed germination (%) and stem length (cm) of dodder.

Character / Extract	Germination (%)		Stem length (cm)	
JM	85.0	a	6.19	a**
SQ	72.0	b	7.40	a
AJ	0.0	c	0.00	b
Control	79.0	ab	6.63	a
L.S.D. (0.05)	10.4		2.13	

****Mean within the same column followed by the same letter are not significantly different at 0.05 level of probability**

It could be concluded that, both extracts of jew's mallow and squash do not contain effective chemical compounds in inhibiting germination and growth of dodder. The strong growth of dodder surrounding the jew's mallow stem insured the highly susceptibility of this plant to dodder infection (Fig.,2). Meanwhile, although squash plant does not contain effective compound, it is known to be highly resistant to dodder, indicating the mechanical type of resistance. On the other hand, AJ extract completely precluded germination and growth of dodder, indicating the presence of chemical resistance due to effective components (phenols and terpenoids) inhibiting both processes.

Similar results were reported by Mahran *et.al.*(1974), Nemli (1987), Habib and Rahman (1988), Jain *et.al.*(1989), Meena and Sethi (1994) and Ali (1996).

II.Growth of jew's mallow plant:

Data concerning the effect of different concentrations of aqueous extract of ajowan, belladonna and canna on jew's mallow plants regarding its resistance to dodder, and yield components including plant height, shoot fresh and dry weights are indicated in Tables (3,4,5 and 6).

1-Yield components:

It is evident from Tables (3,4 and 5) that, the 3 types of extracts significantly increased yield components compared with the infected control plants in both seasons. Maximum increase was obtained by using BL extract being 67.2, 138.5 and 151.1% in the first season and 54.5, 162.6 and 186.1% in the second season over the infected control for plant height, shoot fresh and dry weights, respectively. Moreover, there was a corresponding increase in yield components with the decrease of concentration of different extracts relative to the infected control. In contrast, the highest concentration (S) significantly decreased plant height comparing with the infected control, being -44.4 and -45.0% in both seasons, respectively, while the lowest concentration (S_3) gave the maximum increase in plant height, fresh and dry weights being 104.4, 187.3 and 222.7% in the first season and 95.0, 228.8 and 281.0% in the second season, respectively, over the infected control.

Table (3): Effect of different concentrations of aqueous extracts of ajowan,belladonna and canna on plant height (cm) of jew's mallow during the two successive seasons 2002 and 2003

Extract / Concnt.	Plant height (cm)							
	First season				Second season			
	AJ	BL	CN	Mean	AJ	BL	CN	Mean
S	0.0	0.0	30.0	10.0	0.0	0.0	33.0	11.0
S_1	25.7	37.3	25.0	29.3	27.3	35.1	27.0	29.8
S_2	43.0	39.0	19.0	33.7	46.0	37.6	20.0	34.5
S_3	45.3	47.0	18.1	36.8	48.1	50.8	18.0	39.0
Infected cont.	18.0	18.0	18.0	18.0	20.0	20.0	20.0	20.0
Intact cont.	39.0	39.0	39.0	39.0	42.0	42.0	42.0	42.0
Mean	28.5	30.1	24.9		30.6	30.9	26.7	
L.S.D.$_{(0.05)}$								
Extract (E)	3.6				3.1			
Concnt. (C)	4.7				4.2			
ExC	8.1				7.8			

Table (4): Effect of different concentrations of aqueous extracts of ajowan, belladonna and canna on fresh weight (g) of jew's mallow plants during the two successive seasons 2002 and2003.

Extract / Concnt.	Fresh weight (g)							
	First season				Second season			
	AJ	BL	CN	Mean	AJ	BL	CN	Mean
S	0.0	0.0	270.8	90.0	0.0	0.0	265.3	88.4
S_1	130.7	247.3	127.8	168.6	128.2	250.0	120.9	166.4
S_2	314.8	289.8	98.0	234.2	340.0	280.0	95.6	238.5
S_3	330.0	342.0	95.0	255.7	350.8	368.6	89.3	269.6
Infected cont.	89.0	89.0	89.0	89.0	82.0	82.0	82.0	82.0
Intact cont.	305.8	305.8	305.8	305.8	310.9	310.9	310.9	310.9
Mean	195.1	212.3	164.4		202.0	215.3	160.7	
L.S.D (0.05)								
Extract (E)	9.6				10.1			
Concnt. (C)	12.4				11.6			
ExC	21.5				19.9			

Results of interaction between extract type and concentration in both seasons revealed that the tallest jew's mallow plants were higher than the infected control by 138.9 and 130.0% in S_2 concentration and 151.7 and 140.5% in S_3 concentration for AJ extract or 161.1 and 154.0% in S_3 concentration for BL extract. The same trend was obtained with fresh and dry weights.

Table (5):Effect of different concentrations of aqueous extracts of ajowan, belladonna and canna on dry weight (g) of jew's mallow plants during the two successive seasons 2002 and 2003.

Extract / Concnt.	Dry weight (g)							
	First season				Second season			
	AJ	BL	CN	Mean	AJ	BL	CN	Mean
S	0.0	0.0	24.1	8.0	0.0	0.0	23.8	7.9
S_1	15.6	23.5	14.6	17.9	15.0	23.8	13.6	17.5
S_2	33.5	29.4	10.5	24.5	37.4	28.7	9.9	25.3
S_3	36.5	38.7	10.0	28.4	39.7	41.6	8.9	30.1
Infected cont.	8.8	8.8	8.8	8.8	7.9	7.9	7.9	7.9
Intact cont.	32.1	32.1	32.1	32.1	33.4	33.4	33.4	33.4
Mean	21.1	22.1	16.7		22.2	22.6	16.3	
L.S.D.(0.05)								
Extract (E)	2.2				2.3			
Concnt. (C)	2.8				2.7			
ExC	4.9				5.1			

Comparison between jew's mallow plants treated with the different types and concentrations of the extracts, and the intact control plants revealed that, there were significant decreases in the three yield components of treated plants in both seasons. Belladonna extract gave the minimum decreases, being -22.8, -30.6 and -31.2% in the first season and -26.4, -30.7 and -32.3% in the second season less than the control for plant height, fresh and dry weights, respectively.

Increasing the concentration of all extracts caused significant and corresponding decreases in yield components comparing with the intact control plants. The highest concentration (S) gave the maximum decrease in yield components, being -74.4, -70.6 and -75.1% in the first season and -73.8, -71.6 and -76.3% in the second one for the 3 studied characters, respectively.

Interaction between extract type and concentration showed the same previous trend as either S_2 or S_3 for AJ extract or S_3 for BL extract gave the tallest plants and highest fresh and dry weights of jew's mallow plants comparing with the intact control in both seasons. In the first season, the highest increasing ratios were 16.2 and 20.5% in plant height, 7.9 and 11.8% in shoot fresh weight and 13.7 and 20.6% in shoot dry weight for ajowan and belladonna extracts, respectively. While in the second season, the increases were 14.5 and 21.0% in plant height, 12.8 and 18.6% in shoot fresh weight and 18.9 and 24.6% in shoot dry weight for both extracts, respectively.

Comparison between results of the studied characters of infected and intact plants during the two seasons, indicated that infected jew's mallow plants were significantly reduced than those of the intact ones by -53.8, -70.9 and -72.6%, and -52.4, -73.6 and -76.3% in the first and second seasons, for plant height, shoot fresh and dry weights, respectively.

The highest concentration (S) of ajowan or belladonna extracts caused the death of jew's mallow plants due to the toxicity of that concentration of both extracts to the host and parasite plants. Meanwhile, using low concentrations (S_2 or S_3) of canna extract weakened their effect on dodder plants and activated the growth and connection of parasite plants with the vascular tissues of host plants, absorping their nutrients and giving yellowish colour leading to senescence stage (Figs,2 and 3).The present results are in agreement with those obtained by Habib and Rahman(1988) and Ali(1996).

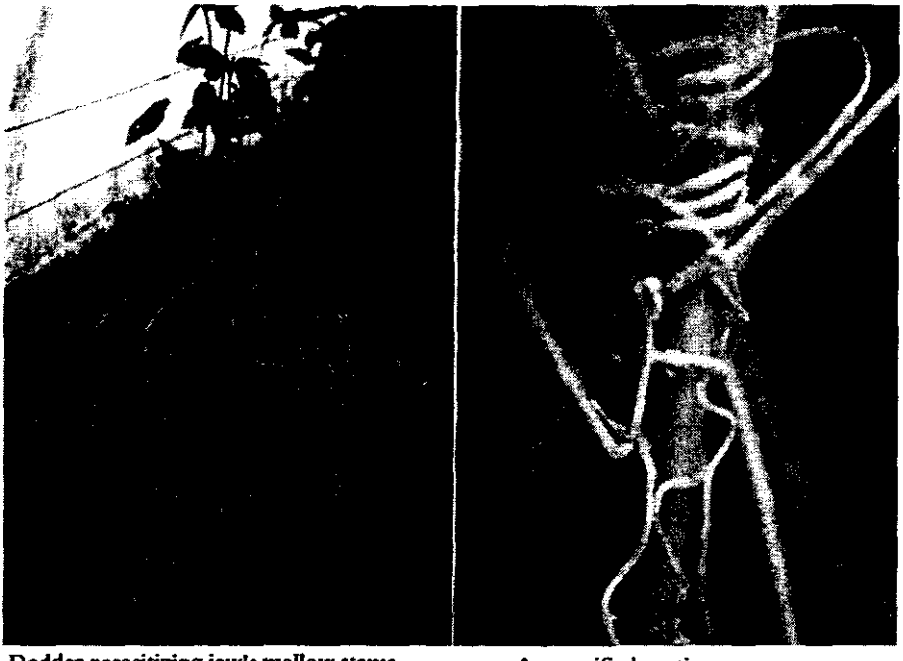
2- Resistance of jew's mallow plants against dodder infection :

The percentages of jew's mallow plants sprayed with the 3 extracts and resisted infection with dodder plants are indicated in Table(6).

The three types of extracts significantly increased jew's mallow resistance percent against dodder infection, and ajowan was the highest being 75.4 and 76.4 %, followed by belladonna, giving increases of 68.8 and 67.6 %, while canna was the lowest, being 23.6 and 23.8 % in both seasons, respectively.

In addition, all adopted concentrations of extracts significantly increased dodder control percent, as S concentration was the highest, being 90.7 and 89.7 % in the two successive seasons, respectively, then the ratio gradually decreased with lowering the concentration of different extracts.

Results of interaction between extract type and concentration revealed that, spraying AJ extract or BL at S or S_1 concentration gave the highest dodder control percent, being almost 100 % in both seasons. No differences were detected between infected control and the treatment with canna extract at S_2 and S_3 concentrations, as both did not preclude growth, coiling and penetration of dodder plants in the host stem.



Dodder parasitizing jew's mallow stems A magnified portion

Fig. (2): Parasitism of dodder (*Cuscuta campestris*) on jew's mallow (*Corchorus olitorius*) plants
Notice: coiling the threads of the parasite around the host stem.

Fig. (3): Effect of parasitism of dodder on jew's mallow plants showing symptoms of yellowness of leaves and death of host plant.

Table (6): Effect of spraying jew's mallow plants with different concentrations of aqueous extracts of ajowan, belladonna and canna on controlling dodder infection (%) during the two successive seasons 2002 and2003.

Extract Concnt.	Control percentage of dodder infection							
	First season				Second season			
	AJ	BL	CN	Mean	AJ	BL	CN	Mean
S	100.0	100.0	72.0	90.7	100.0	100.0	69.0	89.7
S_1	100.0	95.0	46.0	80.3	100.0	98.0	50.0	82.7
S_2	92.0	83.0	00.0	58.3	94.0	80.0	00.0	58.0
S_3	85.0	66.0	00.0	50.3	88.0	60.0	00.0	49.3
Infected cont.	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
Mean	75.4	68.8	23.6		76.4	67.6	23.8	
$L.S.D_{(0.05)}$								
Extract (E)	2.7				2.6			
Concnt. (C)	3.5				3.4			
ExC	6.1				5.9			

It could be concluded that, application of AJ extract at either S_2 or S_3 concentration gave the highest dodder control percent among all treatments without affecting the host plant, being 92.0 and 94.0 % or 85.0 and 88.0 % in both seasons, respectively. This was accompanied with the highest yield components as indicated previously in Tables (3,4 and 5).
Similar results were obtained by Mahran *et. al.* (1974), Kalpana *et.al.,* (1986), Habib and Rahman (1988), Meena and Sethi (1994) and Ali (1996).

III.Anatomical studies:

The internal structure of infected stem of jew's mallow plant, exhibited remarkable response to treatments under study, comparing with intact and infected untreated stems.

Most of the studied characters of jew's mallow plants at the low levels (S_2 and S_3) of AJ and BL extracts were not suppressed, and increased the vascular system, acting as a growth stimulant, compared with untreated control plants. On the contrary, the high levels of extracts, i.e; S_1 for AJ and BL as well as S and S_1 for CN extract, significantly reduced the values of studied growth characters of jew's mallow plants comparing with the intact untreated plant inferring these high levels could act as growth inhibitors for jew's mallow plants.

Microscopical measurements and photomicrographs of cross sections of the main stem of jew's mallow plants treated with S_1 and S_3 concentrations of AJ extract (as an examples for chemical inhibition and stimulation, respectively) compared with both intact and dodder-infected controls are given in Table (7) and Fig.(4, A,B,C and D).

Data showed that the high concentration (S_1) of AJ extract reduced stem diameter by -46.6% less than the intact untreated control, due to the decrease in cell size of various stem tissues, i.e; epidermis (-25 %), cortex (-51.8%), fibers (-46.7%) and pith (-55.9%) less than the control, (Fig.,4 A and C). This could be attributed to the inhibitory effect of the high concentration of

AJ extract which inhibited both cell division and elongation, and consequently the decrease in thickness of tissues. The diluted concentration (S_3) of the same extract gave a less decrease percentage (-9.8%) in stem diameter comparing with the intact untreated control. This was accompanied with the decrease in thickness of certain tissues, i.e; cortex (-30.1%), fibers (-33.3%) and pith (-14.9%) less than the intact control, while there was an increment in vascular tissue thickness, i.e; phloem (30.0%) and xylem (27.3%) over the intact control. This compensated the decrease percentage of stem diameter, (Fig.,4 A and D).

Table (7): Measurements in microns of certain anatomical features in transverse sections through the middle internode of the main stem of infected jew's mallow plants treated with ajowan extract.

Traits (µ)	Intact cont.	Infected	± % to cont. intact cont.	(Ajowan extract) High concnt. (S_1)	±% to infected cont.	±% to intact cont.	Low concnt. (S_3)	±% to infected cont.	±% to intact cont.
Stem diam.	4343.2	3178.1	- 26.8	2318.0	- 27.1	- 46.6	3919.3	+ 23.3	- 9.8
Epidermis thick.	12.2	7.6	- 37.5	9.2	+ 20.1	- 25.0	12.2	+ 60.1	0.0
Cortex thick.	253.2	248.1	- 2.0	122.0	- 50.8	- 51.8	176.9	- 28.7	- 30.1
Fiber strands thick.	91.5	67.1	- 26.7	48.8	- 27.3	- 46.7	61.0	- 9.1	- 33.3
Phloem tissue thick.	61.0	61.0	0.0	61.0	0.0	0.0	79.3	+ 30.0	+ 30.0
Xylem tissue thick.	167.8	176.9	+ 5.5	164.7	- 6.9	- 1.8	213.5	+ 20.7	+ 27.3
Pith thick.	1486.9	793.0	- 46.7	655.8	- 17.3	- 55.9	1265.8	+ 59.6	- 14.9

The comparative anatomy between stems of infected jew's mallow plants and those infected and treated with high and low concentrations of AJ extract, revealed that the high concentration (S_1) reduced stem diameter by -27.1%, than the infected control plants, due to the decrease of cortex (-50.8%), fiber strands (-27.3%), xylem tissue (-6.9%) and pith (-17.3%), while epidermis increased by 20.1%, (Fig.,4 B and C). On the other hand, the lowest concentration (S_3) increased stem diameter by 23.3% over the infected.

Results of microscopic examination of infected stems of jew's mallow with dodder, revealed that the successful penetration and connection of the haustoria of dodder, severly affected the growth of jew's mallow stems and inhibited cell division and elongation, causing decreases in stem diameter by -26.8%, due to the decrease of thickness of epidermis, fibers and pith by -37.5, -26.7 and -46.7%, respectively, compared with the intact untreated plants, (Fig.,4 A and B).

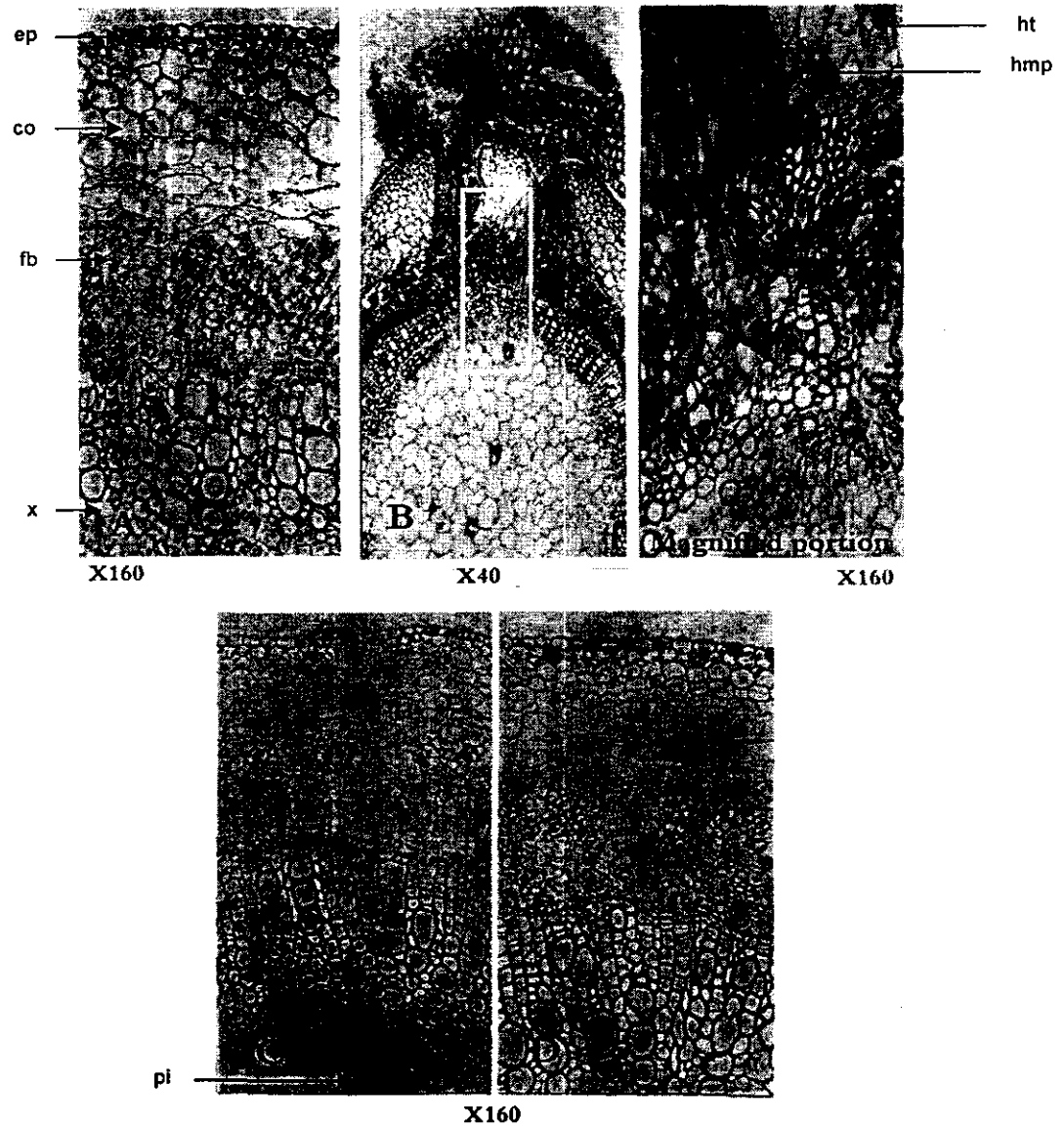


Fig.(4): Transverse sections through the middle internode of the main stem of jew's mallow plants.

A- Intact control. B- Infected control.

C- Infected and treated with high conc. (S_1) of ajowan extract.

D- Infected and treated with low conc. (S_3) of ajowan extract.

(Details: co, cortex; ep, epidermis; fb, fibers; hmp, haustorium of the parasite; ht, host tissues; pi, pith; x, xylem).

control, due to increasing thickness of; epidermis (60.1%), phloem tissue (30.0%), xylem tissue (20.7%) and pith (59.6%) over the infected control plants, (Fig.,4 B and D).

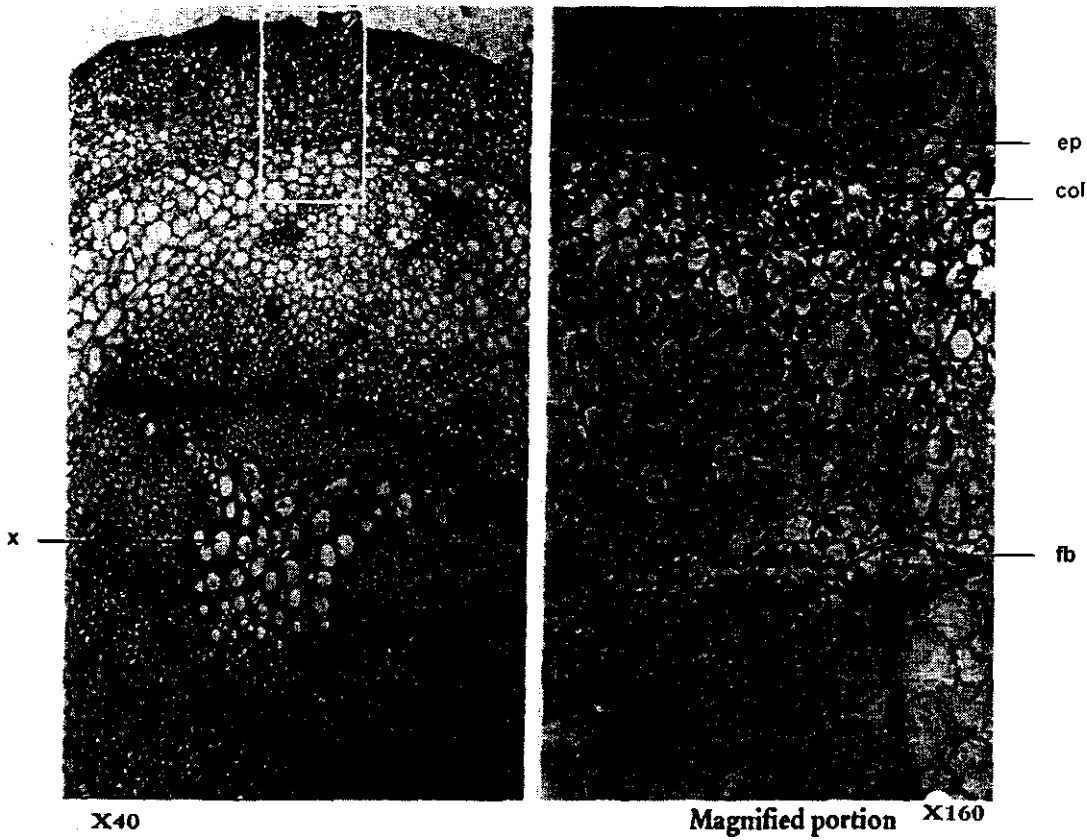


Fig.(5): Transverse sections through the middle internode of the main stem of squash plant showing the anatomical resistance type represented in collenchyma tissue and complete fibrous ring in the cortex.
(Details: col, collenchyma; ep, epidermis; fb, fibers; x, xylem).

Apart from the study of JM plants, it was thought to study the nature of resistance of SQ plant to dodder infection as spraying dodder plants with its extract was not effective, while the haustoria failed to penetrate SQ stems, and if penetrated it failed to connect with vascular tissues of the host plant. This could be attributed to the presence of tough fibers in the fiber bundles as stated before, and the great increase in thickness of epidermis and collenchymatous tissue in the cortex, (Fig., 5).
The structure of the fiber bundles in JM stem is different, as many areas of parenchymatous cells are spreading between the fibers, that made the tissues tender and facilitated the penetration and connection of the haustoria with the host plant (Fig.,4B).

It is clear from the previous anatomical study that, inspite of the positive effect of high and low concentrations of AJ extract in increasing resistance to dodder infection, the high concentration caused a negative effect on the anatomical characteristics of JM stem, while that effect was minor with the low one, comparing with the intact control plants. Thus the high concentration seems to be toxic for both host and parasite due to allelopathic compounds, while in SQ the anatomical structure of the stem was responsible for resistance. These results are in agreement with those obtained by Capderon *et.al.,* (1985), Nemli (1987) and Al -Menoufi and Ashton (1991).

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تأثير بعض المستخلصات النباتية على الصفات المورفولوجية والتشريحية لنبات الملوخية وطبيعة مقاومته للعدوى بالحامول

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*** قسم النبات الزراعى – كلية الزراعة – جامعة القاهرة**

تم دراسة تأثير المستخلصات المائية لنباتات النخوة الهندى و البلادونا و الكنا على نمو الحامول المتطفل على نباتات الملوخية لمعرفة أى من تلك المستخلصات يؤثر على طبيعة المقاومة للحامول (ميكانيكية – كميائية). و قد أوضحت نتائج نمو الحامول وجود تثبيط تدريجى بزيادة تركيزات المستخلصات المختلفة وقد أدى استخدام مستخلص النخوة الهندى الى الحصول على أفضل النتائج الايجابية يليه البلادونا بينما كان الكنا أقلها . وعلى العكس من ذلك فقد زادت مكونات المحصول الخضرى (الأوزان الطازجة و الجافة) لنباتات الملوخية بنقص تركيز المستخلصات المختلفة حيث أدى استخدام أقل تركيز لأى من مستخلص النخوة الهندى أو البلادونا الى الحصول على أعلى مكونات للمحصول الخضرى. و قد أوضحت معاملة بذور الحامول بمستخلص الملوخية عدم وجود أى تأثير على إنباته مشيرا الى الحساسية العالية للملوخية للعدوى بالحامول بينما لوحظ وجود مقاومة كميائية بدرجة واضحة عند المعاملة بمستخلص النخوة الهندى. و قد تمثل ضرر التركيز العالى لمستخلص النخوة الهندى فى نقص النمو الخضرى و قطر الساق للملوخية. و قد توصلت الدراسة التشريحية الى أن ذلك النقص يعزى الى النقص فى سمك الأنسجة المختلفة برغم الفشل التام للطفيل فى اختراق بشرة العائل. و قد أعطى استخدام أقل تركيز لمستخلص النخوة الهندى تأثيرا عكسيا حيث أدى الى زيادة سمك الجهاز الوعائى لساق الملوخية برغم أن نسبة مقاومته للحامول بلغت ٨٦,٥%.