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Effect of foliar application with garlic extract and Liquorice root extract and Salicylic acid on vegetative growth and flowering and flower set of tomato and under unheated houses

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ABSTRACT

This study was conducted in the plastic houses unit ,Department of Horticulture ,College of Agriculture University of Baghdad during the growing season 2010 - 2011 to investigate the influences of garlic treatment and foliar sprays with Liquorice root extraet and Salicylic acid on vegetative growth , flowering and flower set percentage to tomato grown under unheated plastic houses (cv Wgdan) during the growing season 2010-2011 . Results showed that gararlic extraet significantly increased the number of leaves. Foliar sprays with Liquorice root extraet at the rate of 2.5 g.L⁻¹ and salicylic acid at the rate of 100 mg.L significant increased the high of plant, number of leaves ,leaf area , number of flower , the number of flower punches. The interaction between the experimental factors significantly influenced most vegetative and flowering characters. The interaction between the three factors garlic extraet , Liquorice root extraet and Salicylic acid significantly influenced the vegetative characters (height of plant 231.67 cm), (number of leave 36,67 leave/plant), (leaf area 109.96) ,(dry weight vegetative growth 227.85g / plant) and flowering characters (number of flower 11.67 flowe /punches), (number of flower punches 10.67 punches/plant) and (flower set 72.61 %) specially the higher concentration of salicylic acid.

INTRODUCTION

The tomato *Lycopersicon esculentum* Mill is a member of the important vegetable crops which is used fresh and procceded . Resently the plant extracts was used to promote the vegetative and the yield of many crops through its influences in different physiological activities in the plants. Al-Gawary (2002) found that the influence of Liqorice root extract was the same as the influence of GA3 50 the Liqorice root extract induce cell division and cell elongation due to AG3 content so that it increased the vegetative growth and induced flowering and fruit set and also Liqorice root extract contain charbohydrates which used by the growing plant and the Liqorice root extract increased Plant content of Auxins so that it red uced the apical domnonence in the apical buds.

Syngé (1971) showed that garlic extract contain high percentage of amino acid which contain sulphare such Mothinine and cysteine which is very important in the biological activities in the plant. Lee skoog (1965) notecd that Salicylic acid induce flowering of tabbaco plant *Nicotiana tabacum* in tissue culture when kinetine was used and also indol acetic acid and the influences was notecd in different plant feamlies . Due to these effects of these compounds in decreasing the influenced of elcological factors and increasing plant growth and yield so that these compounds NM chosen to used in the study.

MATERIALS AND METHODS

This study was conducted in the plastic houses unit , Department of Horticulture ,College of Agriculture University of Bughdad during the growing season 2010 -2011 to investigate the influences of garlic treatment and foliar sprays with Liquorice root extraet and Salicylic acid on vegetative growth , flowering , flower set percentage of tomato growen under unheated plastic houses condition .The seed of tomato hybride culture (Wgdan) was planted on 5/10/2010 and the seeling was transpLETED to plastic houses on 1/12/2010 . The organic manure was added during plwing at the rate of 2m³ for each house (180m²) .The soil was ferlized using methuyI bromide . The plants was fertilized with chemical fertilizer at the rate of 35kg urea and 35kg N.P.K (27.27.0)for the plastic houses in four times the first one at 2 weeks after transplanting and at one month interval and the agronornic practices was done according to (Matlop et al ,1989) . Tomato stems were treated with garlic behind the each flower infournces grown in janury, Februry and March either alon or with Liquorice root extraet at 2.5 g.l⁻¹ and also the tomato plant were foliary sprayed with Salicylic acid at 0,50,100 g.l⁻¹ Tween 20 was added to the solutions during spraying . The Liquorice root extraet was sprayed at three interval 23/1 , 27/1, 4/2 /2011, while spraying salicylic acid at 20/1 , 24/2 ,30/3/2011 .

Friut picking was carried out from 3/4/2011 till 10/6/2011 , the three pioking consederd on early yield.The number and the yield of each replicate each treatment was carried out . The plastic house with 3 mains replicate inter rales roads between them the width of raods was 50cm and the replicate distance 50cm for from the plastic house side,36 maters long each replicate take 2 maters . the tomato plant was spaced at 40 cm and each replicate contain 10 plant . The carried experiment was carried out using (CRBD) with 3 replicates , The means of the treatments was out using LSD at 5% level of significant (Al Rawi & khalFallah , 1980) .

RESULTS AND DISCUSSION

Height of plant

The Results in table (1) showed that no significant effect of garlic treatment and also the foliar spray with Liquorice root extraet on height of the plants, while foliar spray with Salicylic acid significantly influenced height of plant .The interaction between garlic treatment and Liquorice root extraet or with Salicylic acid and the interaction between foliar spray with Liquorice root extraet and Salicylic acid significantly increased height of plants and the heighest plant height was when tomato plants recived the heighest concentration of Salicylic acid and the treatment with garlic or

with the foliar spray with Liquorice root extract . The interaction effect of the three factors significantly increased height of plants to 231.33 cm while the lowest height of plant 211.67cm was in control treatment .This increase in height of plant may be due to the effect of Auxins and the cytokinins while found in the salicylic acid (Shakirova et al.2003) .The Auxins was the meagor factors influencing. the growth of the cambium hayer in the plant and increased the rate of cell division of meristemic cell and increasing plan height and also its role in the activation of photosynthesis enzymes and also increaser the building up of photosynthesis pigments and increased the photosynthesis products (Hayat et al .2007)

Number of leaves

Treating tomato stems with garlic significantly increased the number leaves in the plant and that is the same with foliar spray with either Liquorice root extract or Salicylic acid (Table 2) the interaction between garlic treatment and Liquorice root extract or garlaric treatment with Salicylic acid or Liquorice root extract and Salicylic acid significantly increased the number of leaves per plant specially when Salicylic acid used at the higher concentration of 100 mg .l⁻¹ . The interaction between three factor significantly gave the highest number of leaves per plant 36.67 leaf plant while the lowest number of 26.33 leaf plant was in control treatment, the ratio of increase was 39.27 % . This increase may be due to the effect of Liquorice root extract which contain high level of Gibberellins and Carbohydrate (Al-Gawari ,2002) or may be due to the Salicylic acid which as a plant hormone which promote photosynthesis enzymes and increased photosynthesis activities (Hayat et al ,2007) and then increased biomass and then increased of the number leaves in plant specially then treatment in increased the number of vstem per plant (Table 1) . The results agreed with . the result obtained by (Saidoon et al ,2002) in tomato plant and with (Yildirim et al ,2008) in cucumber plants.

Table (1) Effcet of garlic treatment and foliar spray with Liquorice root extract and salicylic acid on tomato height of plant (Wagdan cv.) 2010 -2011 season .

Dose G	Dose S	Dose SA			S*G
		aS0	aS1	aS2	
G0	S0	211.67	228.67	227.50	222.61
	S1	215.67	224.00	229.33	223.00
G1	S0	218.33	223.33	231.33	224.44
	S1	225.33	224.17	231.67	226.83
L.S.D 0.05		16.863			(n.s)
AS*G					G

G0	213.67	226.33	228.42	222.81
G1	221.67	223.57	231.50	225.64
L.S.D 0.05	(n.s)			(n.s)
AS*S				S
S0	215.00	226.00	229.58	223.53
S1	220.33	224.08	230.33	224.92
L.S.D 0.05	(n.s)			6.884
AS	217.67	225.04	229.96	
L.S.D 0.05	8.431			

Table (2) Effect of garlic treatment and foliar spray with Liquorice root extract and Salicylic acid of the number leaves per tomato plant (Wagdan cv.) 2010 -201 season .

Dose G	Dose S	Dose SA			S*G
		aS0	aS1	aS2	
G0	S0	26.33	27.67	30.00	28.00
	S1	29.00	33.67	34.00	32.22
G1	S0	29.67	34.67	30.67	31.67
	S1	34.00	34.67	36.67	35.11
L.S.D 0.05		3.171			3.475
AS*G					G
G0		27.67	30.67	32.00	30.11
G1		31.83	34.67	33.67	33.39
L.S.D 0.05		3.159			1.259
AS*S					S
S0		28.00	31.17	30.33	29.83
S1		31.50	34.17	35.33	33.67

L.S.D 0.05		3.297		1.295
AS	29.75	32.67	32.83	
L.S.D 0.05		1.586		

Leaf area Disemeter²

Table (3) showed a significant increases in leaf area per plant when tomato plants treated with garlic and the increases was about 20 disemeter² as compared with the untreater plants. Foliar sprays with Liquorice root extraet or Salicylic acid and the interaction between Liquorice root extraet and Salicylic acid or the interaction between garlic treatmen and Liquorice root extraet or between garlic treatment with Salicylic acid also increased leaf area per plant . The highest leaf area per plant was recorded when tomato plant treated with garlic with the high concentration of Salicylic acid or garlic treatmen and Liquorice root extraet.

The interaction between three factors significantly increased leaf area per plant and the highest leaf area of 109.96 disemeter² was recorded when tomato plants were treated with garlic and spray with Liquorice root extraet and Salicylic acid at 100mg.l⁻¹ , while the lowest leaf area of 74.45 disemeter² was in the control treatment with ratio of increases of 47.70 % , this increases was due to the effect of Liquorice root extraet which contain Mevalonic acid which the precosure of Gibberellins (Al-Daroush ,1977) or that the Liquorice root extraet behave an Gibberellins in its influence in plant growth . the increases in leaf area may be due to the influence of Salicylic acid in increaseng the activity of photosynthetic enzyme and increasd biomas and then leaf area or it role in increaseng the growth of the rooting system in which in the center for cytokinine production which also influence plant growth and leaf area is one of these paramerters and this agreed with the results obtaind by (Abdle -wahed et al , 2006)

Dry weight of vegetative parts (gm)

The experiment at results presented in Table(4) showed No significantly effect of treating tomato stems with garlic or foliar spray with Liquorice root extraet or Salicylic acid on dry weight of vegetative parts .The interaction between rarlic treatment and Liquorice root extraet or Salicylic acid gave no significant effect on Parameter.

The interaction between three factors significantly increased this dry weight of vegetative parts up to highest value of 227.85gm while the lowest value of 206.58 mg was in control treatment with a percentage of increase of 10.30% and this increase may be due to the effect of Liquorice root extraet which resemble the effect of the Gibberellin (Mc intyer , 1971) and the effect of garlic which contain sulfure (Syngé , 1971) and the effect of Salicylic acid which also increased the apical merstamtic cell division in the roots (Usha and Singh, 2003) which increased water up take (Hayat et al ; 2003) and also due to the increases in chlorophyll contain in the leaves which increased the photosynthesis product (Khodary ,2004) and this agreed with the results found by (

Zagglol and Mahgoob ,2002) and (Saidoon et al.2002) on tomato plants respectively.

Table (3) Effect of garlic treatment and foliar spray with Liquorice root extract and Salicylic acid on leaf area of tomato plant (Wagdan cv.) 2010 -2011 season.

Dose G	Dose S	Dose SA			S*G
		aS0	aS1	aS2	
G0	S0	74.45	76.04	78.83	76.44
	S1	75.52	81.23	84.31	81.02
G1	S0	85.15	85.56	100.03	90.25
	S1	103.08	107.07	109.96	107.00
L.S.D 0.05		7.416			5.761
AS*G					G
G0		74.94	79.63	81.57	78.73
G1		94.56	96.32	104.99	98.63
L.S.D 0.05		9.793			3.028
AS*S					S
S0		79.80	80.80	89.43	83.34
S1		89.75	95.15	97.14	94.01
L.S.D 0.05		14.924			3.028
AS		84.76	78.98	93.28	
L.S.D 0.05		3.708			

Table (4) Effect of garlic treatment and foliar spray with Liquorice root extract and Salicylic acid on dry weight of tomato plant (Wagdan cv.) 2010 -2011 season.

Dose G	Dose S	Dose SA			S*G
		aS0	aS1	aS2	
G0	S0	206.58	213.07	222.50	214.87
	S1	210.10	219.85	213.98	214.64
G1	S0	209.14	220.50	210.55	213.40
	S1	209.58	210.24	227.85	214.89
L.S.D 0.05		18.416			(n.s)
AS*G					G
G0		209.58	216.49	218.24	214.76
G1		207.86	215.37	219.20	214.14
L.S.D 0.05		(n.s)			(n.s)
AS*S					S
S0		209.06	216.78	216.53	214.77
S1		208.84	215.09	220.92	214.14
L.S.D 0.05		12.592			(n.s)
AS		208.72	215.91	218.72	
L.S.D 0.05		(n.s)			

There is no significantly effect of garlic treatment or the foliar sprays with Liquorice root extract on the number of flowers in punch per plant (Table 5) , while foliar sprays with Salicylic acid significantly increased this Parameter and the effect of the interaction between the treatment with garlic and foliar sprays with Liquorice root extract on this parameter was not significant , while the interaction between foliar sprays with Liquorice root extract and salicylic acid significantly increased number of flowers in punch . The interaction between three factors significantly increased this parameter . The highest number of flowers in punch per plant 11.67 flower . punch-1 was found when tomato plants was treated with garlic and Liquorice and Salicylic acid at higher concentrations as compared with lowest value 7.33 flower . punch-1 in control treatments and the

percentage of increase was 59.21% . This increases was due to the influence of salicylic acid on the growth of vegetative parts such as height of plant ,number of leaves absorbtion of water and mineral elements and production of biomass and promoting flower intuition and flower number (Hayat et al ; 2007 , Hassun , 1998) and the results of this stady agreed with what found (Kord and Hathout , 1992) on tomato plant .

Number of flowering punch per plant ⁻¹

There is in no significant effect of treating tomato stem with garlic on the number of flowering punch per plant ,while foliar spray with Liquorice root extraet or Salicylic acid significantly influenced this parameter. The interaction between garlic treatment with Liquorice or garlic treatment with salicylic acid or foliar spray with Liquorice root extraet with salicylic acid significantly increased the number of flowering punch . The highest number of flowering punch was found when the highest concentrations of Salicylic acid with garlic treatment or with foliar spray with Liquorice root extraet .The results of the interaction between garlic treatment and Liquorice root extraet and the highest concentrations of salicylic acid showed heighest flowering punch 10.67 punch plant-1 while the lowest number of punch 8.00 punch plant -1 in the control treatment . The percentage of increase was 33.38% these increases may be due to the role of these compound in increasing of growth characters such an height of plant , number of leaves which laid to increases the flowering punch and these is a positive ralution between number flowering punch and number of leaves per plant (Hassun , 1998) .

Table (5) Effcet of garlic treatment and foliar spray with Liquorice root extraet and Salicylic acid on number of flower in punch . plant ⁻¹ of tomato plant (Wagdan cv.) 2010 -2011 season .

Dose G	Dose S	Dose SA			S*G
		aS0	aS1	aS2	
G0	S0	7.33	10.67	11.67	9.89
	S1	9.33	9.67	9.67	9.56
G1	S0	8.00	8.33	10.33	8.89
	S1	8.33	10.00	11.67	10.00
L.S.D 0.05		4.332			(n.s)
AS*G					G
G0		8.33	10.17	10.67	9.72
G1		8.17	9.17	11.00	9.44

	(n.s)			(n.s)
AS*S				S
S0	7.67	9.50	11.00	9.39
S1	8.83	9.83	10.67	9.78
L.S.D 0.05		2.85		(n.s)
AS	8.25	9.67	10.83	
L.S.D 0.05		2.167		

Table (6) Effect of garlic treatment and foliar spray with Liquorice root extract and Salicylic acid on number flowering punch per plant¹ of tomato plant (Wagdan cv.) 2010 -2011 season.

Dose G	Dose S	Dose SA			S*G
		Sa0	aS1	aS2	
G0	S0	8.00	9.33	10.67	9.33
	S1	9.00	9.00	9.67	9.59
G1	S0	8.33	8.33	10.67	8.78
	S1	9.67	10.67	10.67	10.33
L.S.D 0.05		1.742			(n.s)
AS*G				G	
G0		8.67	10.00	10.17	8.17
G1		8.83	8.67	10.50	9.78
L.S.D 0.05		1.286			(n.s)
AS*S				S	
S0		8.16	8.83	10.17	9.06
S1		9.33	9.83	10.50	9.89
L.S.D 0.05		1.253			0.711

AS	8.75	9.33	10.33	
L.S.D 0.05	0.871			

The percentage of flower set.

No significant effect of garlic treatment or Liquorice root extract or Salicylic acid on the percentage of flower set of tomato plant (Table 7). The interaction between garlic treatment and foliar spray with Liquorice root extract or Salicylic acid or the interaction between foliar spray with Liquorice root extract or salicylic acid significantly increased the percentage of flower set. The highest percentage of fruit set was when high concentrations of salicylic acid and garlic treatment was used or with Liquorice root extract. The interaction between three factors showed that garlic treatment and foliar spray with Liquorice root extract and the foliar spray with salicylic acid at the rate of 100 mg.L⁻¹ gave the highest value of 72.61% as compared with lowest value of 64.91% in the control treatment with a percentage of increase of 11.86%. The increases in the percent of flower set may be due to the influence of salicylic acid in promoting vegetative growth and production of biomass, flowering and flower set (Hussan, 1998) and may be due to the role of Salicylic acid on making the plant more resistant to the frost injuries by activating the antioxidant enzyme (Horvath et al.; 2007) and also the role of Salicylic acid on activating Rubisco enzyme which is responsible about fixing CO₂ on Calvin cycle and increasing biomass production (Khodry, 2004, Taiz and Zeiger, 2006).

We can summarize from this study that garlic treatment with foliar spray with 2.5 mg.L⁻¹ Liquorice root extract and Salicylic acid at 100mg.L⁻¹ significantly influenced vegetative growth and yield of tomato plant.

Table (7) Effect of garlic treatment and foliar spray with Liquorice root extract and salicylic acid on fruit set % of tomato plant (Wagdan cv.) 2010 -2011 season.

G	esoD	Dose S	Dose SA			S*G
			Sa0	Sa1	Sa2	
G0		S0	64.91	86.72	65.15	66.26
		S1	66.34	66.34	70.23	67.83
G1		S0	65.36	68.49	69.64	67.64
		S1	67.14	68.80	72.61	69.52

L.S.D 0.05	4 . 77 6			3.052
AS*G				G
G0	65.63	67.53	67.69	66.95
G1	66.25	68.65	71.12	68.67
L.S.D 0.05	3.430			(n.s)
AS*S				S
S0	65. 14	68.61	67.40	67.05
S1	66.74	67.57	71.14	68.58
L.S.D 0.05	3.287			(n.s)
AS	68.09	69. 4 1	69 .49	
L.S.D 0.05	(n.s)			

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