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CORRELATION BETWEEN PRESENTATION OF CAUMARIN AND ITS DERIVATIVES IN PLUM TREES (*Prunus domestics* L.) AND ITS RESISTANCE FOR INFESTATION WITH APHID, *Hyalopterus arundinis* (FABR)

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ABSTRACT

The chemical analysis of spring and autumn leaves of plum can give important informations for the relation between chemical components and the susceptibility of plum leaves to be infested with aphid. So, spring and, autumn leaves from the local plants *Prunus domestica* L. were subjected to chemical analysis to isolate the flavonoid coumarins which are phenylpropanoid in origin especially those formed by ring closer to a C_6-C_3 compound such as o-hydroxy cinamic acid. Results revealed that spring and summer leaves, have been containing either hydroxy or oxy-coumarin (HC or OC) in the C_3, propane unit. Whereas the autumn leaves contain coumarin with C_3, unsaturated propane unit. When the commercial coumarins were tested against adults of the aphid. *Hyalopterus arundinis* (Fabr) through stretched membrane on synthetic diet, coumarin gave feeding stimulants at $2X10^{-3}$ molar while the other two compounds (HC and OC) changed the effect of the molecule on aphid feeding from stimulatory to inhibitory. Hydroxy coumarin was very feeding inhibitor at $2.5 X 10^{-3}$ molar while oxy-coumarin was lethal at $1.5 X 10^3$ molar. That may, in part, explain why aphid harboured abundantly plum plants in autumn, since the leaves are containing coumarin which used as an antifrost agent and protected them with their adults, from severe cooling during winter. On the contrary, the spring and summer leaves have been containing hydroxy and oxy-coumarin. In Egypt, aphids protect themselves against the low temperature of winter by feeding on Handaquoq and sweet clover in which they have coumarin.

INTRODUCTION

As it is known in cold weather that plum plants *Prunus domestica* L. is harbouring aphids *Hyalopterus arundinis* (Fabr) during autumn and winter seasons to protect them and their eggs from severe winter. The biochemical bases of that behavior is unknown. In Egypt, we have favourable weather during autumn and winter, therefore, aphid lives during those two seasons in nymphs or adults forms not in eggs. It infested plum plants in early autumn and when leaves fell they migrated to either sweet clover *(Trifolium alexandrinium)* or Handaquoq *(Melilotus offlcianalis).* Handaqoaq and sweet clover have coumarin (Gorz *et al.,* 1972; Norris, 1977 and Hedin and Jenkins, 1977). This compound lowers the freezing point and is used as antifrost agent, so, it may be due to the need of aphids for coumarin to protect themselves from cold weather. Aphids left plum leaves in early spring to infest other host plants. The extraction of coumarin derivatives from autumn, spring and summer leaves of plum plants and their aphicidal activity. In this

study we report on the extraction of coumarin and its derivatives found in plum leaves during autumn, spring summer, together with aphicidal bioassay data concerning the aphid *Hyalopterus arundinis*. The wild weed Handaqoaq is grown on drainage canals and in the fields of winter crops.

MATERIALS AND METHODS .

Insect :

The aphid *Hyalopterus arundinis* (Fabr) was reared in laboratory on sweet clover seedling at 21-23 °C, 65-70% R.H. with a photoperiod of 12L: 12D.

Plant extraction:

Leaves grown during autumn, spring and summer from plum plants *(Prunus domestica* L.*)* were collected, extracted and analyzed for their contents from coumarin according to Harborne (1973).

Commercial compounds:

Commercial coumarin was obtained from Merk Co., while Hydroxy-and oxy-coumarin were obtained from Sigma Co.

Applications:

The collected extracts and commercial compounds were subjected for toxicological tests against the young apterous adults of aphid *H. Arundinis* by incorporating them into an artificial feeding diet through parafin stretched membrane according to Erhart (1968a,b) and Salem (1983). For every concentration, three replicate cages were used, each containing ten young apterous adults. Control received only diet. Mortality or deterrent effect was recorded 12, 24 hrs. after applications.

RESULTS AN DISCUSSION

Table (1) shows that autumn plum leaves have mainly coumarin and spring leaves have (50:50) coumarin/hyroxy-coumarin, while summer leaves mainly contain oxy-coumarin. Autum extract contained cumarin did not give any toxic effect, spring extract contained cumarin/hydroxy cumarin (50:50) gave slight toxic effect while summer extract contained oxy-cumarin showed the highest toxicity against the aphid, *Hyalopterus arundinis*, the toxicity increased by increasing oxy-cumarin concentration. Therefore, the toxicity of summer leaves extracts may be due, in part, to those chemical contents of oxy- and hydroxy-coumarin (Matsumoto, 1962) and that explains why aphid migrated off from summer plum leaves.

Results of determination the toxicity commercial cumarin, hydroxy cumarin and oxy-cumarin against the aphid, *Hyalopterus arundinis* are shown in Table (2) which clearly indicated that cumarin did not give any toxic effect up to concentration 4x 10^{-3} molar, hydroxy cumarin showed slight effect (22.64% mortalities) after 24 hr for the highest tested concentration which increased to 82.58% mortalities after 48 hr. Oxy-cumarin gave the highest toxic effect all tested compound since it gave 96% mortality after 24 hrs for concentration 2.6x 10^{-3} molar.

The effect of tested cumarin compound on feeding of aphid expressed by % feeding compared to untreated results are shown in Table

(3) which indicated that feeding % was highest for cumarin treatment while it was very lowest for both hydroxy cumarin and oxy-cumarin by another expression it could be said that hydroxy cumarin and oxy-cumarin had very antifeeding effect. This results are agree with Dreyer and Jones (1981) for flavonoids and related phonetics.

Results in this study proved that hydroxy- and oxy-coumarin are toxic and caused feeding deterrency against aphid *Hyalopterus arundinis* suggesting a role of these compounds in aphid abundant from summer to winter host plants and from winter to summer host plant.

Seasonal changes are affecting coumarin accumulation in plum plants during autumn and winter seasons, while in spring and summer seasons they accumulated hydroxy- and oxy-coumarin in which they are affecting plant resistance to green peach aphids. Salem (1991) reported that indole alkaloids and hyroxamic acid accumulation in plants are affected with high temperature stress (Hanson et al., 1983) and water stressed (Zuniga and Corcuera, 1987), that will explain barley in Egypt-Delta (which there are low temperatures with cold weather) is more susceptible to cereal aphids than wheat.

Table (1): Toxicity of summer, spring and autumn plum leaves extracts against H.arundinis.

Extracted plum leaves	Molar concentration 10^{-3}	% Mortality	
		After l2h	After 24h
Autumn leaves (mainly coumarin)	1	0.00	0.00
	2	0.00	0.00
	4	0.00	2.91
Spring leaves (50:50 coumarin / hydroxy-coumarin)	1	12.32	15.65
	2	21.31	24.64
	4	36.63	43.62
Summer leavs (mainly oxy-coumarin)	1	52.28	58.94
	2	71.26	81.25
	4	97.00	97.00
Control	0.00	0.00	0.00

Table (2) : Toxicity of commercail coumarin, Hydroxy-coumarin and oxy-coumarin against aphid *H. arundinis* survival fed with synthetic diets after 24 hours.

Compounds	Molar concentration 10^{-3}	% Mortality	
		After l2h	After 24h
Coumarin	0.5	0.00	0.00
	1.0	0.00	0.00
	2.0	0.00	0.00
	4.0	0.00	3.33
Hydroxy-coumarin	0.5	2.33	28.97
	1.0	7.99	47.95
	1.5	13.65	63.60
	2.5	22.64	82.58
Oxy-coumarin	0.6	25.64	42.29
	1.0	41.29	61.27
	1.6	73.59	93.57
	2.6	96.00	96.00
Control	0.00	0.00	3.33

Table (3): Antifeedind effect of coumarin, HC and OC against adults of aphids, *H. Arundinis,* after 6 hours in the feeding cages.

Coumarin molar cone. 10^{-3}	Aphid feeding %	HC molar cone. 10^{-3}	Aphid feeding %	OC molar cone. 10^{-3}	Aphid feeding %
0.5	92.66	0.5	32.33	0.6	12.98
1.0 [3]	92.66	1.0	25.64	1.5	9.59
2.0	89.66	1.5	8.99	1.6	3.33
4.0	82.66	2.5	3.33	2.6	0.00

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العلاقة بين وجود الكومارين ومشتقاته فى أشجار البرقوق ومدى مقاومتها لحشرة من البرقوق الدقيقى

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وجد أن التغيرات فى الظروف المناخية طول العام تؤثر على كمية الكومارين الموجودة فى أوراق أشجار البرقوق. فقد أثبتت التحاليل الكيماوية للأوراق فى فصول السنة وجود الكومارين فى أوراق الخريف بينما يحول هذا المركب إلى هيدروكسى كومارين فى الربيع وإلى أوكسى كومارين فى الصيف. وباختبار مستخلصات أوراق البرقوق فى الخريف والربيع والصيف وكذلك الكيماويات التجارية للكومارين والهيدروكسى والأوكسى كورمارين بعد إضافتها إلى بيئة غذائية صناعية على المن وجد أن الكومارين له تأثير منشط على التغذية فى حين أن الهيدروكسى كومارين له تأثير مثبط على التغذية أما الأوكس كومارين فله تأثير سام على الحشرات.

وبالنظر إلى أن الكومارين مادة مضادة للصقيع Anti-Forst agent وخافضا لدرجة التجمد فإن ذلك يفسر لجوء المن إلى أشجار البرقوق فى الخريف للحصول على هذه المادة لكى تحمى الأفراد نفسها من برودة الشتاء فى المناطق ذات الشتاء المعتدل أو الدافئ حيث تقضى الحشرات هذا الفصل فى طور حوريات أو حشرات كاملة وليس فى طور البيضة باللجوء للتغذية على عوائل أخرى تحتوى على الكومارين مثل البرسيم والحندقوق بعد سقوط أوراق الخوخ فى الخريف.

أما فى الربيع والصيف فإن الحشرات تهاجر من أشجار البرقوق إلى العوائل الأخرى نتيجة لاحتواء الأوراق على هذه المواد السامة أو المثبطة للتغذية - وهذا يؤكد أهمية هذه الدراسة فى تحول أشجار البرقوق من نبات حساس للإصابة بالمن فى الخريف إلى نبات مقاوم لنفس المن فى الربيع والصيف.