SOOTY CANKER ON SOME THIN BARK TREES CAUSED BY *NATTRASSIA MANGIFERAE*

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Abstract

Most common such thin or smooth bark trees as, *Crataegus azarolus* L. , *Cupressus sempervirens* L. , *Eucalyptus camaldulensis* Dehen, *Platanus orientalis* L., *Pinus brutia* Ten., and *Prunus amygdalus* Batch., were affected by *Nattrassia mangiferae*(H.&P. Sydow) Sutton & Duko, severity of sooty cankers, bark cracking and slough-off were more conspicuous after three months of inoculation under field conditions when cankers were expanded to 83mm and girdled by 14.5mm^2 on *p. amygdalus* and *E. camaldulensis* , respectively. Most of inoculated hosts failed in the callus formation around infected sites. Poplar cankers continued their acceleration during January to April in Duhok and December, March, April in Zakho plantations, the symptoms of decline trees increased in June and July with outbreak dissemination of stem borers and forest caterpillars. Thus, the hot dry summer and accumulation effects of biotic and abiotic stress as droughts are supported the detection and development of disease.

Result of chemical and biological control in the field gave no prenvent canker development when applied these treatments either in painting with bentonite and nebranet or as benlate sprays on cankers at 2.5g/l.

Key words: *Nattrassia mangiferae,* Stem Cankers, Poplar.

INTRODUCTION

Nattrassia mangiferae (H.&P.Sydow) Sutton & Duko (Deuteromycetes, Sphaeropsidales) is a polymorphic fungus that is cultured as arthrospore stage *Scytalidium dimidiatum* consist clear arthrospores with 1-3 cells, owing to dark brown. It forms *P.* conidiomata on the host tree, and under right cultural conditions. Pycinidium contains pigmented pycniospores with 1-3 cells, the middle cell is darker than the two terminal cells (1). the colonies are fluffy with grayish to black aerial mycelium.

The most common name of diseases caused by *N. mangiferae* called sooty canker or limb wilt that invades thin or smooth bark trees as mulberry ,ash ,citrus, walnut , fig , sycamore , apple , apricot and poplar trees that has been damaged or wounded by freezing , sunscald ,and pruning or other mechanical injury (2 , 3). It is well adapted to hot, dry weather and progresses in stressed trees during hot summer and most cankers develop on unshaded trunks and limbs that face toward the sun (4).

It attacks the cambium and spreads downward, causing sudden wilting of young shoots , limbs ,and whole branches , dieback , sooty cankers,and may excude clear drops of gum depending on the tree species , and staining the wood black (4). Eventually , the bark blisters and cracks open , that later sloughed-off to form elongated sunken cankers with a callused margin , leaves turn bright red-brown but do not fall off (5).

This study aims to determinate the susceptibility duration of some common tree hosts and the development of infection within dominant environmental conditions.

MATERIALS AND METHODS

Susceptibility of tree species:-

One year old transplants of , *Crataegus azarolus azarolus* l., *Cupressus sempervirens* l. , *Eucalyptus camaldulensis* Dehen, *Pinus brutia* Ten., *Platanus orientalis* l., *and Prunus amygdalus* Batch were used in this study. All species were cultivated in the plastic containers under field conditions, stems were cut in the cambium layer to 13 mm in length and 5-7 cm in height above the soil line and inoculated with 9mm discs of the fungal hyphal tips under the inner bark tissues, then covered with wet cotton cushions and tied for 30 days (6).

The results were recorded after three months and included cankers length, cankers and bark slough-off area in addition to callus growth. Cross, tangential, and radial sections of *P. orientalis* samples were prepared after three months of inoculation.

Development rate of sooty cankers in the field:-

The effect of dominant environmental conditions on the sooty cankers was conducted in two poplar plantations in Duhok and Zakho (4-5 years old) during September 2007 to September 2008 .Ten cankered trees in each of the three replications were selected , and labeled for monitoring development of infection during the growing season in response to such environmental factors as temperature , relative humidity , wind velocity and rainfall provided by meteorological centers .The results measured monthly included increasing in cankers depth, bark slough –off , cankers area and callus formation .

Biological and chemical control of stem cankers in the plantations:-

This experiment was conducted in the college nursery to test the efficacy of Benomyl, Tachigazol and the biocontrol *T. harzianum* Th.(20KI) for control poplar decline caused by stem cankers using a mixture of Th.+ Bentonite + Nebranate (20:10:10) to prepare the paint paste (7). In the second treatment, oil paints were used as a carrier of *T. harzianum* 100:1.

The other treatments included: Benlate 2.5g/L. Tachigazole 2ml/L. and Benlate + T. harazianum Th. (20KI) used at a rate of 100ml with 5 x 10^3 spore/ml. *Populus nigra* and *P. xeuramericana* (two years old) were used, the stems cut with a sharp knife to 13mm in length in the cambium layer according to (6). The inoculum consisted of discs 9mm incubated at 28 °C for 5 days.The paint paste was added to the wounding sites after inoculation and tied with parafilm to maintain high moisture.

Tachigazole and Benlate were used separately by spraying inoculated stems until run off using 500ml hand sprayer. Benlate + Th. were applied during two periods. Firstly, Benomyl sprayed on wounded courts, followed by *T. harazianum* after two week. The experiment implemented using Complete Randomized Design (CRD) with three replicates. The results were counted after 75 days by measuring the average of cankers length and cankers area.

RESULTS AND DISCUSSION

Results presented in Table (1) show that all smooth or thin bark trees were very susceptible to *N. mangiferae* causing conspicious symptoms of sooty cankers in the infection sites after three months of inoculation (Fig.1) , bark surfaces were discolored dark brown to black , cracks or peels a way revealing black masses of fungal spores (Fig.2) and sapwood under and around the canker which killed particularly under field conditions (7). Since the fungus enters the plant mainly through wounds in sunburned bark and spreads by spores carried by wind , insects in the field under 40-44 C° that stimulates germination , growth and reproduction of the pathogen (8) .The fungal hyphae invaded the bark, cambium and wood mostly intracellularly (Fig. 3), the cells in the parenchyma of the rays, phloem and xylem became dark in color(9 Cankers area on *P.amygdalus* was expended severely by 83mm and girdled by 14.5mm^2 , girdling area on other tree species that produced differentially with clear effects on *E.camaldulensis*. However, soft and most hard woods contained complexes of protein–pectin and some organic nutrients of Ca^{+2} ,Mg^{+2} which induce pectinate compounds resistible to the pectolytic enzymes excretion by such pathogens as *Fusarium spp.* , *Alternatia alternata* and *N. mangifera* , therefore , necrosis might be restricted in there wounded tissues (11). Some of such hosts as *C.sempevirens, P. orientalis, C.azarolus* and *P. brutia* might be contained preexisting defense structures and others induced in response to their infections such as gums that deposited within and nearest to peripheral cells. Similar conclusions were reported before (12).

Table 1. susceptibility of some forest transplants to sooty canker caused by *N. mangiferae* .

Host	Canker's length/ mm	Canker's area/ mm^2	Girdling area/ mm^2	Callus growth/ mm^2
Crategus azarolus	0.00 d	26.25 d	5.00 c	0.00 b
Cupressus sempevirens	0.00 d	20.75 d	4.00 c	0.00 b
Eucalyptus camaldulensis	5.63 a	83.50 a	16 a	22.5 a
Pinus brutia	1.75 c	59.75 b	12.25 ab	0.00 b
Platanus orientalis	1.75 c	44.50 c	7.00 b	0.00 b
Prunus amygdalus	2.00 bc	83.00 a	14.5 a	0.00 b

* Means followed by different letters vertically are significantly different based on Duncan's Multiple Range test (p =0.05)

** Each value represents mean of three replicates.

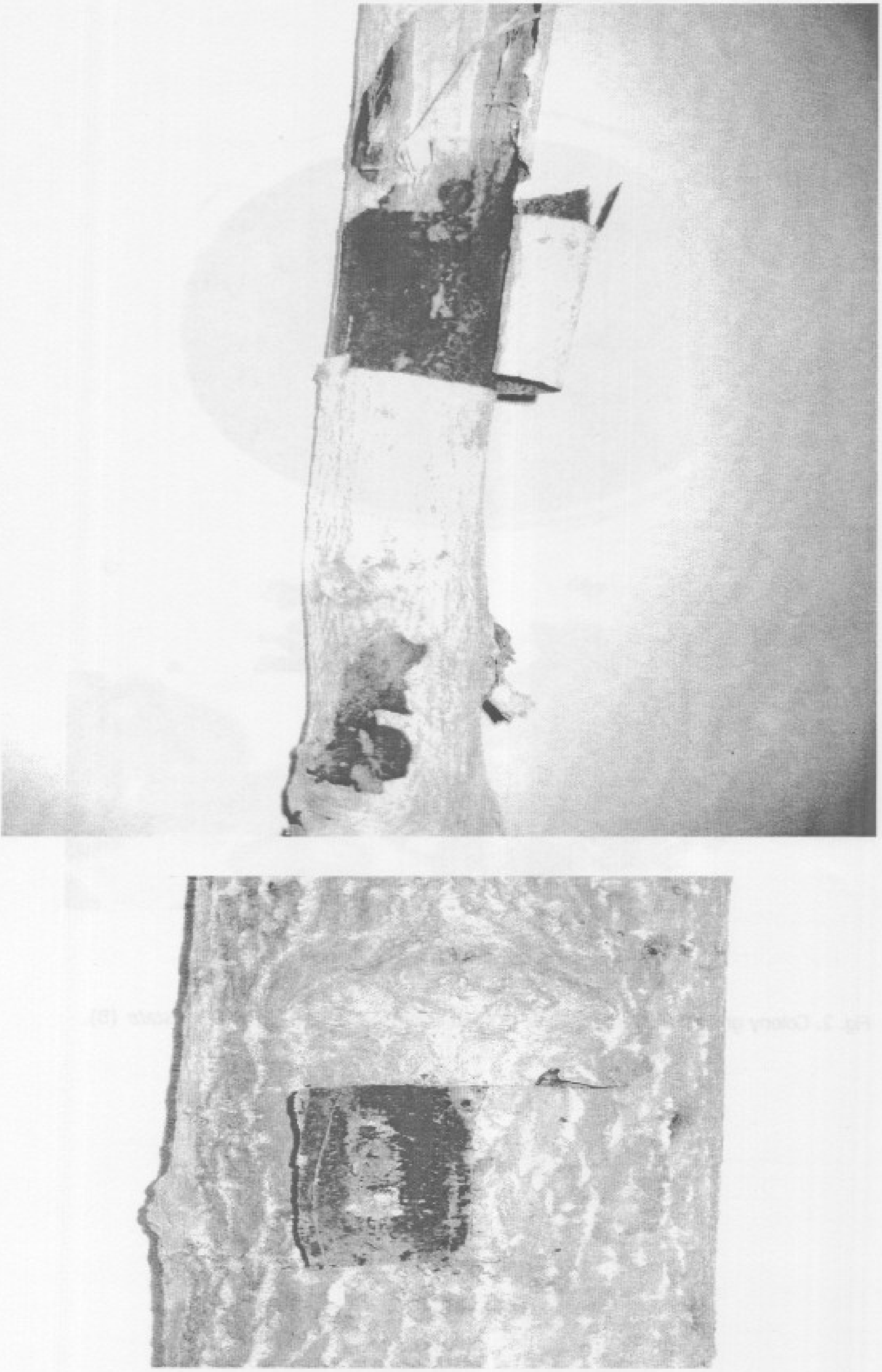
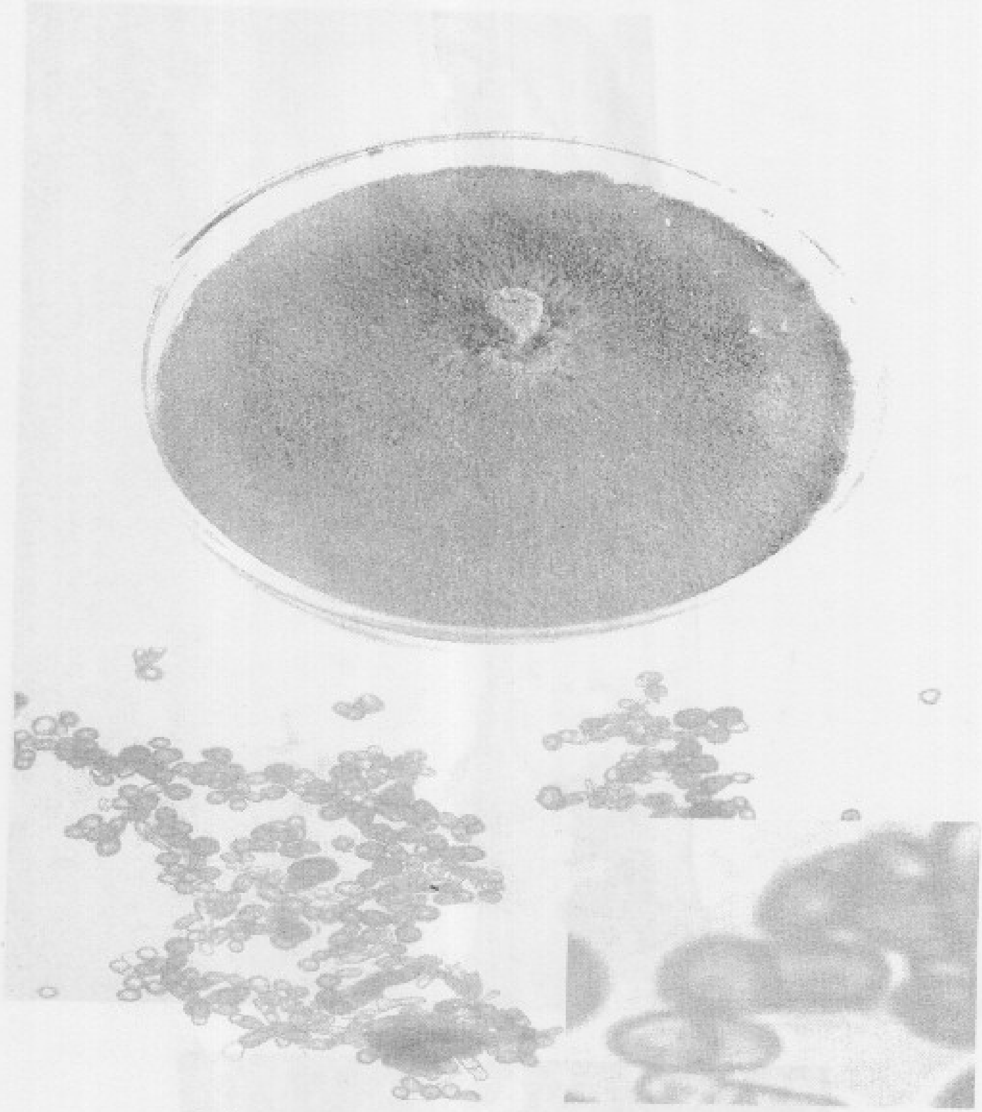


Fig. 1. Conspicious symptoms of sooty canker on the poplar stem and branches.



(A) (B)

Fig. 2. Colony growth of *N. mangiferae* (A) and arthrospores of *S. dimidiatum state* (B).

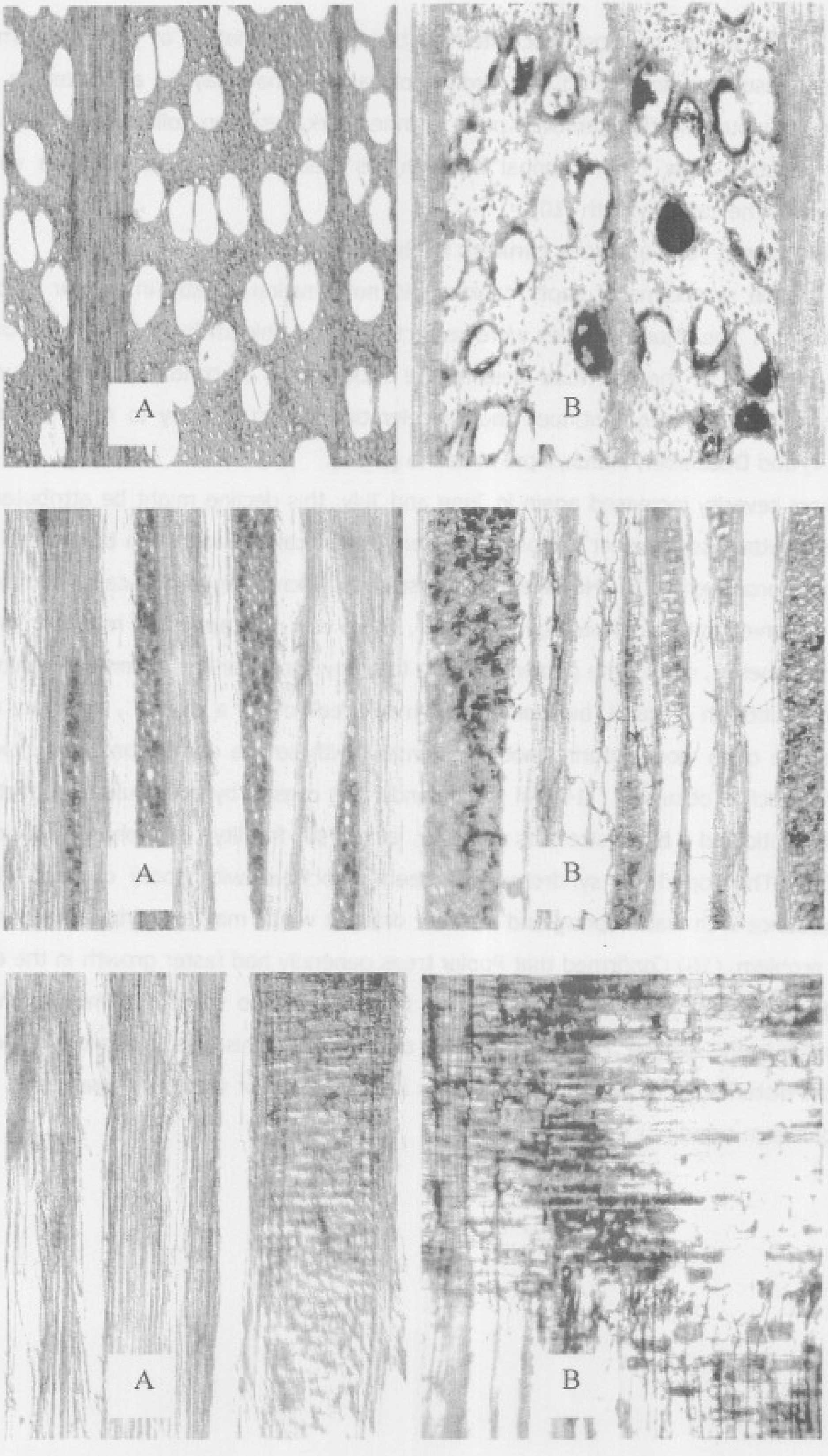


Fig. 3. Cross, tangential and radial sections respectively for *Platanus orientalis* L. inoculated by *N. mangiferae* A- Control B- after 3 month of inoculation.

The failure of most inoculated hosts in their formation of callus confirmed present results in developing and girdling of cankers that may be attributed to the nature of wounding that removed parts of inner bark, resulting collapse and cracking of inoculation sites before fungal invasion, as well as effects of sunburn which prevented the callus growth (10).

Development rate of sooty cankers in the field:

The symptoms of sooty cankers did not develop greatly in a year in both plantations. The injured tissues were restricted in the phloem by 1-1.2 cm thickness with blacking of the sapwood despite the wide range of condition during survey periods .Cankers area continued their acceleration during January to April in Duhok (Fig.4) and December, March, April in Zakho (Fig.5).

Cankers severity increased again in June and July, this decline might be attributed to severe outbreaks of insect vectors particularly forest caterpillars, stem borers and the saddled prominent (13). However, no conspicuous increasing in the callus formation was observed in trees of both two location . There was no a appeared reduction in the stem diameter , since , the poplar with one to many sooty cankers commonly maintain their position in a stand, but some trees may break-off at a canker , or decay may enter the open wound during hot dry summer with severe defoliation , this type of poplar decline observed (14) in Netherlands that caused by accumulative effects of might biotic and a biotic stress as drought , lack of soil fertility , phosphorus deficiency (15). The top dying syndrome has been associated with sooty cankers, stand disturbance with warm spring and summer drought which may exacerbate because of this problem. (16) Confirmed that Poplar trees generally had faster growth in the early stages of growth which suggested that a factor related to stand dynamics might be involved in the decline. However, it is not clear weather this was temporary response to the disturbance or variation of wetness and droughts or weather it was apart of a longer-term trend.

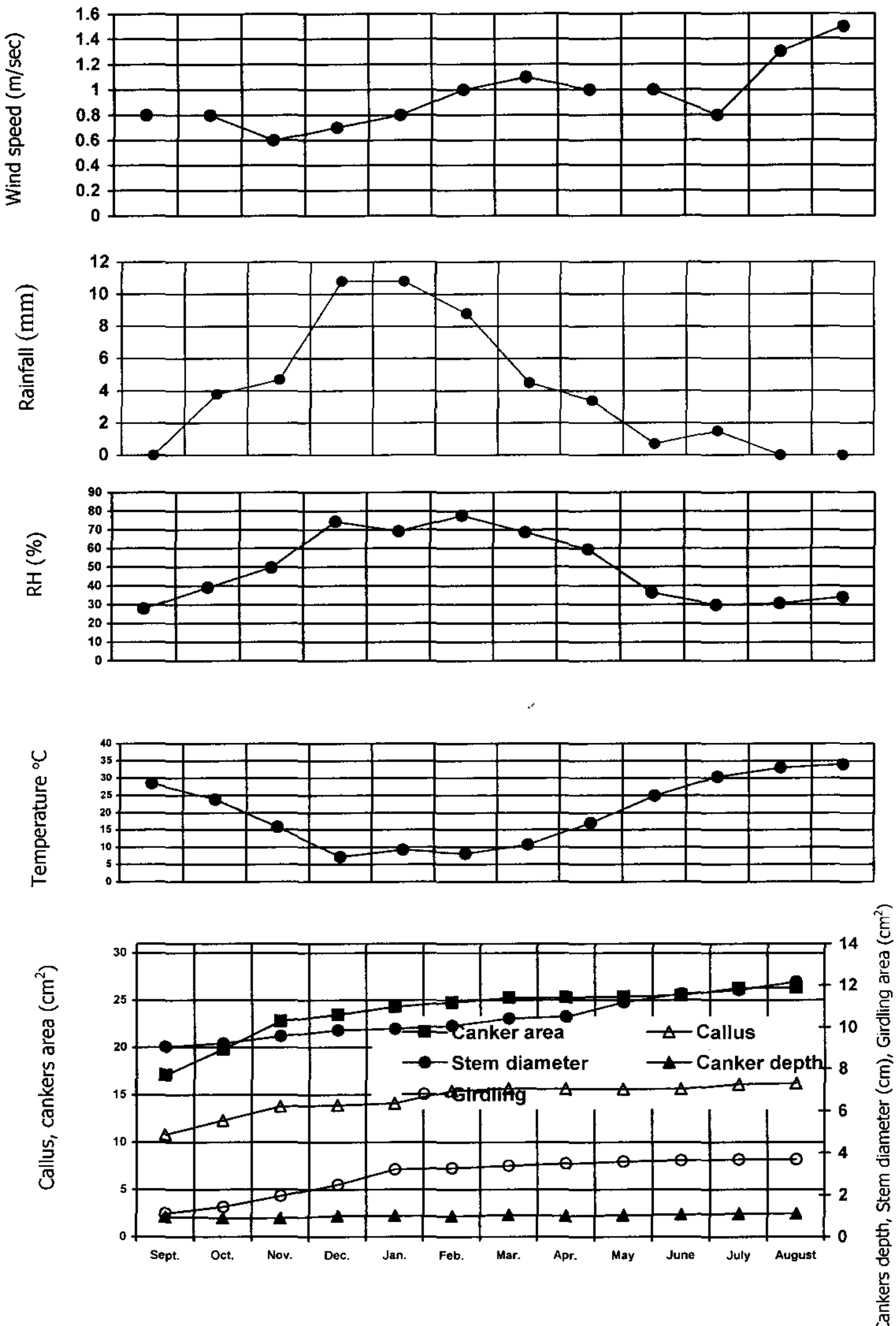


Fig. 4. Effect of temperature, RH, rainfall and wind speed on the cankers area, depth, girdling area and callus formation (Duhok location).

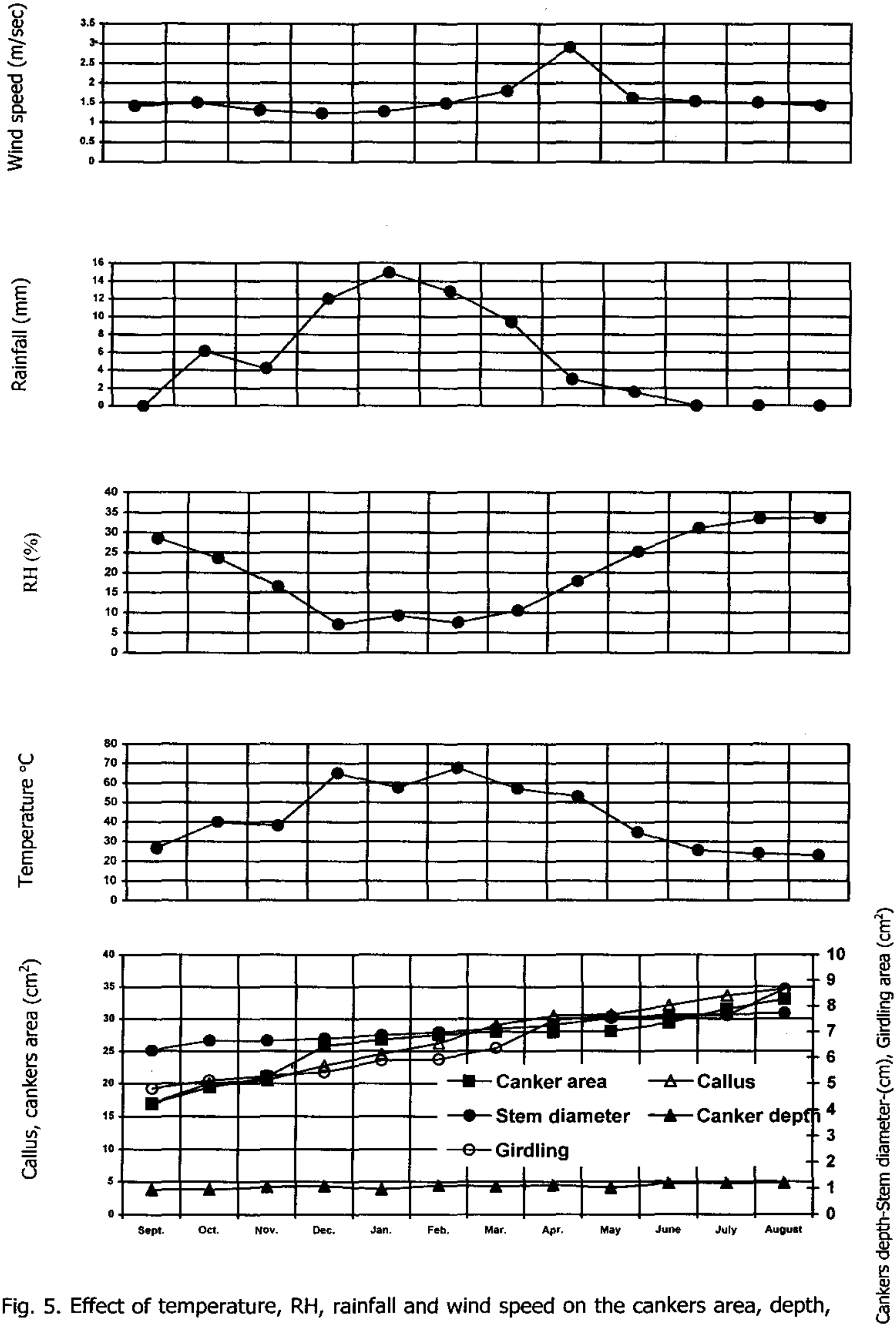


Fig. 5. Effect of temperature, RH, rainfall and wind speed on the cankers area, depth, girdling area and callus formation (Zakho location).

Biological and chemical control of stem cankers in the plantations

A sound control program for canker diseases must involve both preventative and curative methods. The best preventive measure is to unnecessary wounding for establishment of most canker infections. The results of chemical and biological application in the field revealed the effect was less of most treatments in preventing canker development particularly with susceptible hybrid poplar. Therefore, successful control of cankers require removing the affected parts and that chemical control was not effective (16). There were significant differences among all treatments and control (Table 2), particularly when using Tachigazole. This lack of chemical control may contribute to lossing of tree vigor "the key to good health". The pathogen also may remain viable in uncomposted plant debries and thus pose a threat to landscape trees. In this aspect *Alternaria alternata*, *Cephalosporium acremonium* and *N. mangiferae* were viable in over 50% of the branch sections even after 59 weeks (17).

However, results illustrate developing of cankers by 11, 17.78 mm long with applying Tachigazole, Benlate + *T. harazianum* respectively. Cankers area ranged between 117.22 and 163.33 mm^2. Furthermore, infection of living tress influenced by some biotic and a biotic stress factors such as drought, insect defoliation or herbicide damage, in addition to trees predisposition trees to canker's infection , and tree age.

Table 2. Biological and chemical control of stem cankers in the plantations.

Poplar species	Treatment	Cankers length/mm	Cankers area/mm^2
	Control	32.44 a	284.44 a
	Biocontrol + Pentonite + Nebranate	17.89 c	140.56 bc
P. xeuramericana	Oil paints + Biocontrol	16.22 cd	149.00 bc
	Benlate	18.22 c	157.56 b
	Tachigazole	11.00 e	117.22 c
	Benlate + Biocontrol	17.78 c	149.89 b
	Control	28.11 b	258.67 a
	Biocontrol + Pentonite + Nebranate	17.11 cd	155.11 b
P. nigra	Oil paints + Biocontrol	17.78 c	137.89 bc
	Benlate	14.11 d	132.44 bc
	Tachigazole	14.89 cd	162.67 b
	Benlate + Biocontrol	14.78 cd	163.33 b

Mean followed by different letters vertically are significantly different based on Duncan's Multiple Range Test ($p = 0.05$)

Each value represents mean of three replicates.

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التقرح السخامي على بعض الأشجار ذات القلف الرقيق المتسبب عن *Nattrassia mangiferae*

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أظهرت الدراسة ان الاشجار ذات القلف الرقيق مثل الزعرور *Crataegus azarolus L.* والسرو *Cupressus sempervirens L.* واليوكالبتوس *Eucalyptus camaldulensis Dehen* والجنار الشرقي *Platanus orientalis L.* والصنوبر البروتي *Pinus brutia Ten.* واللوز *Prunus amygdalus Batch.* تتأثر لإصابتها بالفطر (H.&P.Sydow) Sutton&Duko *Nattrassia mangiferae* ، وظهرت شدة التقرح الفحمي وتشقق القلف وتقشرها بشكل واضح بعد ثلاثة أشهر من العدوى بلقاح الفطر تحت ظروف الحقل ، وامتدت التقرحات بطول ٨٣ ملم وانفصل القلف بطول ١٤,٥ ملم^2 لاشجار اللوز واليوكالبتوس على التوالي ، وفشلت معظم العوائل المختبرة في تكون الكالس حول مواقع الاصابة.

أوضحت نتائج تطور التقرح الفحمي على أشجار القوغ في المشجر استمرار تدهورها خلال كانون الثاني، شباط، أذار ونيسان في دهوك وكذلك خلال كانون الأول واذار ونيسان في زاخو، وأزداد مقدار تدهور هذه الاشجار في حزيران وتموز حيث الانتشار الواسع لحفارات السيقان والحشرات القارضة ، وعليه فأن المناخ الجاف والحار صيفا والاجهاد الناتج عن العوامل الحيوية وغير الحيوية ومنها الجفاف تدعم موضوع تكشف وتطور المرض.

أوضحت نتائج المقاومة الكيميائية باستخدام البنليت ٢,٥ غم / لتر ماء مع البنتونايت والنبرانيت وكذلك المقاومة البيولوجية باستخدام T. harzianum في الحقل انها لم تمنع تتطور التقرح سواء عند استخدام هذه المعاملات رشاً او بطلاء منطقة التقرح.

الكلمات المفتاحية:- *Nattrassia mangiferae* ، تقرحات الساق ، القوغ.