

SURVEILLANCE OF APPLE CANKER AND IDENTIFICATION OF CANKER PATHOGEN IN APPLE ORCHARDS AT DISTRICT ZIARAT (BALOCHISTAN)

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ABSTRACT

Apple canker is one of the important diseases of apple orchards across apple growing region of Balochistan. For assessment of the existence, magnitude and extent of canker affected trees in district Ziarat, a surveillance study was conducted in active season during 2016 across district Ziarat. In this study, ten different locations were surveyed where 200 apple trees were randomly examined per location and the number of apple trees affected by canker were recorded. The selected locations were: Chowter, Manna, Kan, Kwas, Pachi, Sanjavi, Tanawani, Waam, Warchoom and Zandra, respectively. Thirty samples of cankered tree were collected for isolation and identification of the canker causing agent (*Neonectria ditissima*). The study revealed that among ten locations, three locations viz. Sanjavi, Kan and Waam, showed higher canker incidence where both Red delicious and Katja were severely affected by canker pathogen. In case of Sanjavi, both Red delicious and Katja varieties manifested 45% and 40% cankered trees but no canker symptoms were observed on Golden delicious followed by 48% cankered trees of Katja at Warchoom and 42% cankered trees of Red delicious at Waam. While Katja variety at Kan and Waam indicated 34.4% and 34% cankered trees. However, Chowter, Manna and Kwas were at low risk and less number of trees indicated canker symptoms. So, it is suggested that detailed research studies should be conducted to find out the economic losses caused by canker infection and to devise effective control strategies, in order to protect the apple orchards from further damage by canker.

Keywords: Survey, Apple orchards, Canker disease, Ziarat

INTRODUCTION

Production of deciduous fruits in Balochistan has a special advantage over other fruit growing areas, because of its environmental condition. The diversity of climatic conditions in the province ranging from temperate to sub-tropical and tropical is quite conducive for growing various fruits (FAO, 1993). Out of these deciduous fruits, apples are the first largest planted fruit in Balochistan and it covers 0.101 million hectares with a production of 0.2-24 million tones. Apple contributing more than 42% and 23% of total areas and production of the country's respectively (GOP, 2012). Apple grown in the province is famous for its special taste and quality. But due to diseases and insect pests infestation have resulted in low and poor quality apple fruit production leading to drying of branches and finally death of trees. Among them, apple canker is one of the most important diseases of apple orchards in Balochistan particularly in district Ziarat.

Apple canker is caused by various fungal pathogens that decrease growth and yield of apple orchards and even death of trees. The canker causing agent is *Neonectria ditissima* (Tul. & C. Tul.) previously called *Nectria galligena* which is considered as serious problem of apple trees in Eur-

ope and other countries the world over (Rossman and Palm-Hernandez, 2008; Weber, 2014). The scientific literature has indicated that fruit canker pathogen was first recorded in North America (Plante *et al.*, 2002) and its phylum class subclass order and family are Ascomycota, Sordariomycetes, Hypocreomycetidae and Hypocreales and Nectriaceae respectively (Castlebury *et al.*, 2006, Chaverri *et al.*, 2011).

The canker disease of fruit trees including apple have been recorded globally but predominantly in Australia, Chile, Europe, Japan, New Zealand and S. Africa (Grove, 1990, Xu and Robinson, 2010, Beresford and Kim, 2011; Weber, 2014). According to Beresford and Kim (2011) that the climatic conditions having >30% rainfall and 11-16°C temperature across period of five months per year are quite conducive for causing severe canker in deciduous fruit trees. In addition to that severity and distribution of fruit trees canker is affected by localized climatic factors such as poor soil drainage, low soil fertility and altitudes (Weber, 2014; Brandt, 1964). The canker pathogen viz. *Neonectria ditissima* not only infects deciduous fruits but also various forest trees of hardwood (Farr *et al.*, 1989; Braun and Craig, 2008).

The canker pathogen (*Neonectria ditissima*) can affect trees of any age. Its symptoms on apple tree appear as sunken areas on stem and branches with small gloomy reddish color. In addition, these symptoms also appear on the bases of shoots, leaf scars as well as wounds (Weber, 2014). The canker infections at the base of side shoot which later on become larger branch produce outsized lesions on stems or main branches. In response to such infection, a pathogen barrier is developed by the host tree around the infected sites that lead to swelling area (Beltra *et al.*, 1969). Concentric wrinkles can be seen in the old cankered wood that results due to alterations in seasonal growth rate of host and *N. ditissima*. The cross-sectional view of cankered branch manifests area of brown color while *N. ditissima* hyphae can be found in cavity of xylem vessels (Ventura *et al.*, 2004; Weber, 2014). Further symptoms can have differentiated in the form of white fruiting bodies as asexual reproduction organ (conidial spore) in cankered branch during summer and early autumn whereas, sexual reproductive organ (perithecia) appears in spring, autumn and winter as red fruiting bodies (Weber, 2014). Additionally, the higher application of nitrogen fertilizer particularly fresh farmyard manure and water stress on coarse texture soil increase risk of canker infection. Furthermore, shoot growth rate also triggers risk of canker attack i.e. higher shoot growth more canker risk. Similarly, varietal susceptibility to canker can vary across different locations. Scion varietal susceptibility can also be affected by less vigorous rootstock and Red delicious is one of highly susceptible apples varieties to canker. Keeping in view the importance of apple canker disease, the present study was designed to investigate the incidence of canker in terms of percent cankered trees and to record the magnitude and extent of apple canker across district Ziarat and also confirm the apple canker symptoms associated with identification of canker causing pathogen in laboratory.

MATERIALS AND METHODS

Ziarat is one of the main apple growing districts in Balochistan where apple fruits are of premium quality and have high market value over other districts. However, the climatic changes resulted not only in yield reduction but also triggered the attack of diseases and insect pest on apple orchards. Among the diseases, apple canker is one of the important diseases of apple orchards across apple growing region of Balochistan. In this context, a surveillance study was conducted in active season during 2016 across district Ziarat. In this study, ten different locations were surveyed where

200 apple trees were randomly examined per location and the number of apple trees affected by canker were observed and recorded. The selected locations were Chowter, Manna, Kan, Kwas, Pachi, Sanjavi, Tanawani, Waam, Warchoom and Zandra, respectively. Basically, district Ziarat comprise of two Tehsil viz. Ziarat and Sanjavi where sanjavi, Tanawani and Chowter comes under Tehsil Sanjavi and other locations comes under Tehsil Ziarat (Fig 1). In each location three apple varieties viz. Red Delicious, Golden Delicious and Katja were counted among the 200 apple trees and noted the affected variety as per specified symptoms of canker. The incidence of canker on apple trees was recorded as percent cankered trees while canker incidence risk was measured as given in Table 1.

Table 1. Risk of canker incidence

Canker incidence (% cankered trees)	Risk
No canker	No risk
<5%	Low
5-25%	Moderate
>25%	High

Through the surveillance study, the canker affected apple trees across the district were noted in per-centile as shown in Table 2. The canker affected apple tree samples were collected from each apple variety per location and in this way 30 samples were collected and brought to the plant pathology laboratory at Directorate of Agriculture Plant Protection ARI Sariab Quetta for isolation and identification of the canker causing agent (*Neonectria ditissima*) following the standard laboratory procedure. The cankered samples were cut into small pieces and surface sterilized using 70% alcohol for one minute. The isolation of *N. ditissima* cankered wood was carried out on water agar media following the method described by Anagnostakis and Ferrandino (1998). The inoculated media was incubated at 20°C for 2- 3 weeks. After incubation, the fungal growth was examined under compound microscope to identify the fungus *N. ditissima*. The field symptoms of canker were confirmed through identification of *N. ditissima* in the laboratory.

RESULTS AND DISCUSSION

Ziarat is the prominent district of apple growing region of Balochistan where highly delicious and tasteful apple fruits are produced that fetch greater market price as compare to the apple of other districts in Balochistan. This high- quality fruit production of apple in Ziarat is due to conducive environment prevailing pleasant summer and cold to extremely cold winter which is necessary for meeting the chilling hours of apple.

Table 2: Existence of canker in apple trees, its magnitude and prevalence at ten different locations across District Ziarat, Balochistan Pakistan

Location	Fruit trees	Total No. of trees surveyed (200 trees) /loc.	Canker affected trees					Canker affected trees in Percent
			Healthy	Less affected patches on single branch or spurs)	Sunken stem affected	Main limbs affected	Number of affected trees	
Sanjavi	Red delicious	40	22	4	2	12	18	45.0
	Golden delicious	10	10	-	-	-	-	0.0
	Katja	150	90	30	-	30	60	40.0
Tanawani	Red delicious	120	95	8	3	14	25	20.8
	Golden delicious	30	29	1	-	-	1	3.3
	Katja	50	39	-	4	7	11	22.0
Chowter	Red delicious	170	167	3	-	-	3	1.8
	Golden delicious	5	5	-	-	-	-	0.0
	Katja	25	23	2	-	-	6	8.0
Pachi	Red delicious	137	98	7	12	20	39	28.5
	Golden delicious	8	8	-	-	-	-	0.0
	Katja	55	48	2	-	5	7	12.7
Zandra	Red delicious	140	127	6	2	5	13	9.3
	Golden delicious	16	14	2	-	-	2	12.5
	Katja	44	35	6	-	3	9	20.5
Manna	Red delicious	145	141	-	-	4	4	2.8
	Golden delicious	4	4	-	-	-	-	0.0
	Katja	51	42	5	-	4	9	17.6
Kwas	Red delicious	92	80	4	2	6	12	13.0
	Golden delicious	7	7	-	-	-	-	0.0
	Katja	101	95	2	-	4	6	5.9
Warchoom	Red delicious	137	110	12	2	13	27	19.7
	Golden delicious	11	9	-	-	2	2	18.2
	Katja	52	27	13	4	8	25	48.1
Kan	Red delicious	107	73	21	2	11	34	31.8
	Golden delicious	3	3	-	-	-	-	0.0
	Katja	90	59	14	3	14	31	34.4
Waam	Red delicious	88	51	18	5	14	37	42.0
	Golden delicious	16	14	2	-	-	2	12.0
	Katja	94	62	5	6	21	32	34.0

Recently, the climatic changes resulted in reduction of growth and yield of apple orchards and intensified the attack of diseases and insect pests. Now, it has been found that all apple varieties are showing severe mites infestation and apple canker incidence. Apple canker disease is recognized as one of the important diseases in all apple growing districts in Balochistan particularly in Ziarat that leading to drying of branches and even death of trees. In this context, the present study was initiated to assess the magnitude and extent of canker incidence in apple orchard and to determine its risk rate across Ziarat district through surveillance study.

In this study ten different locations viz. Sanjavi, Tanawani, Chowter, Pachi, Zandra, Manna, Kwas, Warchoom, Kan and Waam were selected in district Ziarat. In each location, 200 apple trees were surveyed for canker incidence in which number of varieties was also recorded. The surveillance study was designed to observe healthy and canker affected trees out of 200 trees in each location as shown in Table 2. The canker symptoms noted in the surveillance area were resem-

blance with those indicated by Agrios (1997) while red spot as sunken area was due to the presence of sexual reproduction organ (Perithecia) of *N. ditissima* (Lortie, 1964; Weber, 2014).

In the survey area, it was appraised that Red delicious and Katja were the dominant apple varieties grown on large scale due to its appealing color and taste and high market value. But Golden delicious was planted in negligible numbers in each location because the main objective of this cultivar was not to fetch high market price but to enhance pollination process of the other two varieties and it works as a pollinizer for them.

The surveillance study revealed that among ten locations, three locations viz. Sanjavi, Kan and Waam, were at high risk of canker incidence where both Red delicious and Katja were severely affected by canker pathogen. In case of Sanjavi, both Red delicious and Katja varieties manifested 45% and 40% canker affected trees but no canker symptoms were observed on Golden delicious followed by 48% cankered trees of

Katja at Warchoom and 42% cankered trees of Red delicious at Waam while Katja variety at Kan and Waam indicated 34.4% and 34% cankered trees (Table 2). However, Golden delicious exhibited resistance against canker infections and out of 10 locations, only four locations were found canker affected which were also affected moderately with maximum of 18.2% cankered Golden delicious trees at Warchoom followed 12% cankered trees at Waam whereas rest of locations showed no symptoms of canker pathogen attack on Golden delicious. Red delicious at Chowter and Manna were found at low risk of canker incidence and minimum of 1.8% cankered trees were recorded at Chowter and 2.8% at Manna with 13% cankered Red delicious trees at Kawas which were moderately affected while Katja variety at these three locations were moderately affected by canker. The scientific literature has also revealed that there are large differences among apple varieties against *N. ditissima* (Braun, 1997, Pedersen *et al.*, 1994).

The reason behind this fluctuation in canker incidence on apple orchards across the district is that there might be differences in local temperature, soil types, irrigation practices, fertilizer management and altitude. It is evidenced from the Figure 1 and 2 that the locations showing higher canker incidence are away from Ziarat city which are comparatively warmer than the locations (with less canker incidence) closer to Ziarat city because the higher altitude exists in the city area where most of heavy rainfall and snow fall occurs during winter and rainfall in monsoon seasons.

However, due to climatic changes globally, the local climate of Ziarat has also changed and there is less rainfall and snow fall during winter while the difference between day and night temperatures has also widened during winter season leading to number of complexed issues in apple trees like apple bark splitting, canker attack and severe-mite infestation during active seasons. Furthermore, during this changing environment, those apple orchards where farmers have applied balanced chemical fertilizers along with zinc and iron application and carried out approved orchard management practices like proper pruning, irrigating orchard according to its requirement and have applied composted farmyard manure were found healthy with low canker attack. Apple orchards at Chowter, Zandra, Kawas and Manna are close to Ziarat city and are at higher altitude having fertile soil and received improved practices that is why the canker incidence risk was observed low in these orchards.

These observations are in line with those suggested by Beresford and Kim (2011). Similar results were also reported by Weber (2014) and Brandt (1964) who found that local climatic changes, poor soil drainage and high altitude with low fertile soil increased incidence of canker on apple orchards.

In vitro isolation and identification of fungi causing apple canker in the surveillance area of district Ziarat, was carried out and the causal agent was confirmed that was *Neonectria ditissima*. The pattern and mode of

damage of canker infection in all locations were similar because the causal agent was same i.e. *N. ditissima*.

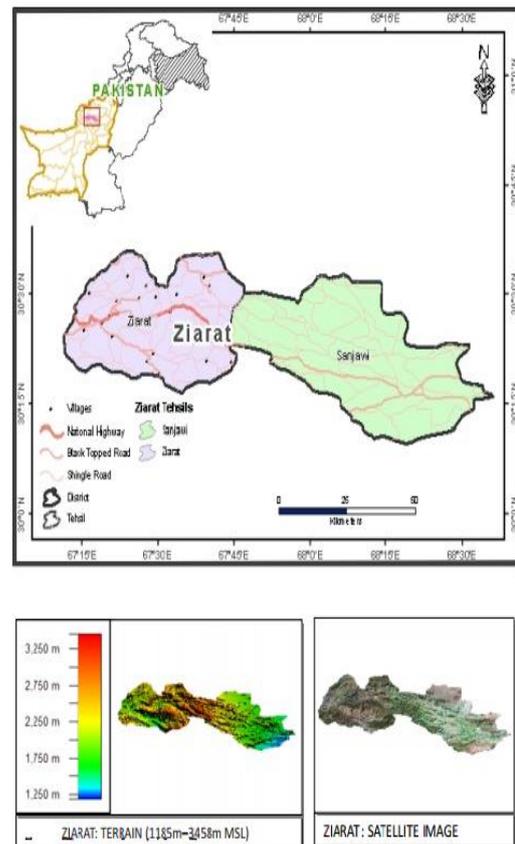


Figure 1: Map of Ziarat District showing ten locations for apple canker surveillance study

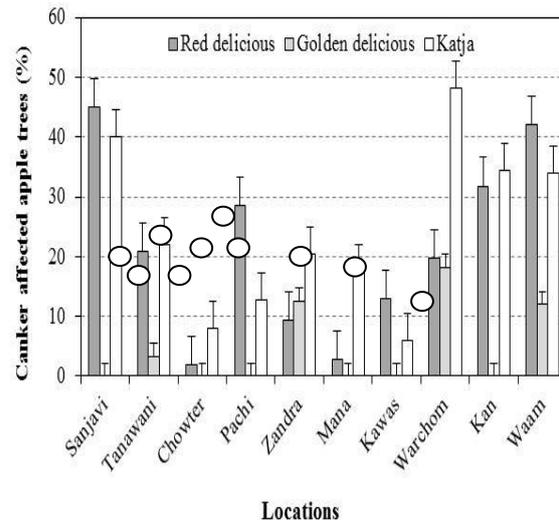


Fig. 2: Canker affected apple trees at different locations across district Ziarat

Same method of isolation and identification of *N. ditissima* from cankered apple trees was conducted by Amponsah *et al.*, (2014). There might be any other *Neonectria* species causing fruit tree cankers including apple, but it needs further detail study.

CONCLUSION

Through surveillance study, it was recorded that majority of Red delicious and Katja varieties across district

were affected by canker disease. Among the ten locations, three locations viz. Sanjavi, Warchoom and Wam indicated high risk of canker incidence where more 30% trees were infected with canker fungi (*Neonectria ditissima*). While Chowter, Manna and Kwas were at low-risk and less number of trees indicated canker symptoms. So, it is suggested that detailed research studies should be conducted to find out the economic losses caused by canker infection and to devise effective control strategies in order to protect the apple orchards from further damage by canker.

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