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RESEARCH ARTICLE

MANAGEMENT OF SWEET ORANGE (*CITRUS SINENSIS* (L.)OSBECK) SCAB CAUSED BY *ELSINOE FAWCETTII*

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ABSTRACT

Citrus scab caused by Elsinoe fawcettii is a serious disease of sweet orange in Andhra Pradesh. It causes severe premature fruit drop, poorer quality and smaller fruits and damage to fruits, which results in heavy losses to citrus industry. Considering the seriousness of the disease in Andhra Pradesh, the present study was conducted under field conditions. The trial was conducted during three consecutive years i.e. 2011-12, 2012-13 and 2013-14. Six treatments viz., Calixin at (0.1%), Carbendizim (0.1%), Hexaconizole (0.2%), Copper oxychloride (0.3%) and untreated check as control were imposed starting from marble stage of fruits at monthly intervals. To manage the bacterial canker, Streptocycline (100ppm) was sprayed along with each treatment. Each treatment was replicated four times. The trial was laid out in a randomized block design. Observations were recorded on fully matured fruits. Pooled analysis was done and the results revealed that fruits treated with Hexaconazole (0.2%) recorded 5.49% incidence followed by Calixin at 0.1% (0.95%) , Carbendizim 0.1% (11.21%), Copperoxychloride 0.3% (18.93%) and Mancozeb at 0.3% (22.8%) and control (T6) 28.04% incidence . Results revealed that, Hexaconazole @ 0.2%, which recorded the lowest (3.14%) disease incidence was found effective and significantly superior over all other treatments with highest benefit cost ratio 1:2.55.

Key words: Citrus scab, Elsinoe fawcetii, Chemical control, Management.

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INTRODUCTION

Citrus scab *(Elsinoë fawcettii* Bitancourt and Jenkins) is widely distributed, occurring in many citrus growing countries in the world where weather conditions are favourable for infection. In India, citrus is the second largest after mango. It is one of the largest fruit industries in the world. India ranks sixth in the production of citrus fruit in the world. In India, citrus fruits are primarily grown in Maharashtra, Andhra Pradesh, Punjab, Karnataka, Uttaranchal, Bihar, Orissa, Assam and Gujarat. At present, in India total area under citrus fruit production is 1078.0 thousand hectare (14.9% of total area under fruits) with a production of 11147.0 thousand MT (12.5% of total production under fruits) and productivity of 10.30 MT/ha and total area under Sweet orange cultivation in India is 334.94 thousand hectare with a production of 3886.20 thousand MT during the season 2013-14. (NHB 2014).

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Citrus cultivation in India is plagued with various problems due to limiting growing conditions, scarce water resources and high incidence of pests and diseases warranting great care from planting till the plants come to bearing in order to sustain a productive life of a minimum of 15-20 years.

Sweet orange scab disease: The disease normally affect citrus in different parts of the world. Citrus scab, also called common citrus scab or sour orange scab is caused by *Elsinoë fawcettii*, while sweet orange scab is caused by another related fungus *Elsinoë australis* (Kunta *et al.,* 2013; Chung, 2010). Naga Lakshmi *et al*. (2014) reported that in Andhra Pradesh 3.2%-16.35% incidence of scab on sweet orange cv. sathgudi was observed across the different *cutrus* growing districts. Citrus scab disease was first discovered in Brazil in 1935 where it caused scab lesions on all areal parts *viz*., citrus fruit, leaves, and twigs and is present in most humid citrus producing areas (Spósito *et al.,* 2011). Sweet orange scab differs from citrus scab primarily with respect to host range. The hosts of citrus scab include rough lemon, sour orange

Rangpur lime, lemons and limes. In Andhra Pradesh sweet orange cv. sathgudi is a popular variety which is grown widely. **Symptoms:** Symptom development starts a few days after infection and is dependent on environmental conditions that promote disease development like warm temperatures and moist plant tissues. The incubation period is at least 5 days. Artificially inoculated seedlings develop scab symptoms after 7 to 14 days (Timmer, 1999. Symptoms generally develop one week after tissue infection (USDA, 2010). Lesions start on the underside of leaves as water soaked spots, typically forming along the edge of the leaf or the mid-vein. Long distance dissemination of *E. australis* is most likely through the movement of infected nursery stock, including budwood (CABI, 2010). Leaves are susceptible to infection when young (flush stage), primarily in the early spring as they emerge from the bud and 'petal fall' commences; thereafter they become immune to infection (Timmer *et al.,* 2000). A protuberance is formed on leaf tissue where the infection develops due to induction of cell hyperplasia and forms a depression on the opposite side.

In addition to the pustules, the leaves exhibit distortions, but if infections develop close to when the leaf becomes resistant or immune, the pustules are smaller and no distortion of the leaf blade occurs (Hernandez and Mendes, 2003). There is a dramatic increase in the resistance of the leaves and fruits to infection in later physiological stages (INTA, 2010). During the six to eight weeks after 'petal fall,' fruits are highly susceptible to *E. australis* (Timmer *et al.,* 2000) or up to 12 weeks after petal fall. Infected fruit readily express symptoms after infection, but tissue susceptibility decreases rapidly as fruit mature (USDA, 2010). Fruits are highly susceptible to *E. australis* during the 6 to 8 weeks after petal fall. Fruits infected in the very early stages of their development are subjected to premature fall. The initial scab forms on immature fruit is slightly raised and pinkish to light brown in colour. As the lesion expands, it takes on a cracked or warty appearance and may change colour to a yellowish-brown and eventually to dark- gray.

The scabs typically form a pattern on the fruit like water splashes. Although there is little affect on internal fruit quality, fruit are severely blemished rendering them unsellable in the fresh produce market. Further, the disease can cause premature fruit drop and stunted young nursery trees on newly established field plantings (Fig.1). The problem with controlling scab in sweet orange is the extended flowering and multiple cropping habits of these trees in warmer areas and the decision of when to apply the protective sprays. In areas where there is only one main crop a year a control strategy is simpler to implement. The best control strategy is to get the first on weather conditions. For example, if the weather conditions are generally dry after the first spray and rainfall events are unlikely to cause a spore release then a second spray at 6 weeks may be all that is required. However if the weather is rainy and it is likely to trigger an infection then the second spray may need to be applied earlier. The relationship of increase in fruit yield was directly and linearly correlated with percentage of reduction in severity of scab and dieback diseases (Siddiquee *et al.,* 2011). Reduction of disease incidence will increase the fruit quality and marketable yield. With this view the present studies were taken to develop a strategy for the management of scab on sweet orange *cv* sathgudi.

MATERIALS AND METHODS

***In vivo* evaluation of fungicides against E. Fawcettii:** The efficacy of the five fungicides *viz*., Calixin(0.1%) +Streptocycline (100ppm) (T1), Carbendazim(0.1%)+ Streptocycline (100ppm) (T2), Hexaconazole(0.2%)+ Streptocycline (100ppm) (T3), Mancozeb (0.3%)+ Streptocycline (100ppm) (T4) and Copperoxychloride (0.3%)+Streptocycline (100ppm) (T5) were tested against sweet orange under field conditions at Citrus Research Station, Dr. YSR Horticultural University, Tirupati, Andhra Pradesh. Fungicides were tested at their recommended concentrations. The plants sprayed with water served as control (T6). Each treatment was replicated four times and each replication was imposed on five plants. Each fungicide was sprayed on the sweet orange trees of 10 years old at 30 day intervals starting from marble size of fruit. In each treatment streptocycline @ 100 ppm was added to avoid bacterial canker.The experiment was conducted in randomized block design.

Disease assessment: The observations on per cent disease incidence were recorded at the time of harvest and the per cent disease incidence (PDI) in each treatment was determined using the formula (Wheeler, 1969). Incidence of scab was assessed by counting the number of infected fruits and expressed as percentage of total fruits assessed. Later percent disease reduction over control was calculated.

$$\text{Percent Disease Incidence (PDI)} = \frac{\text{Number of diseased fruits}}{\text{Total number of fruits inspected}} \times 100$$

Percent disease reduction over control = (C-T) / C) x 100

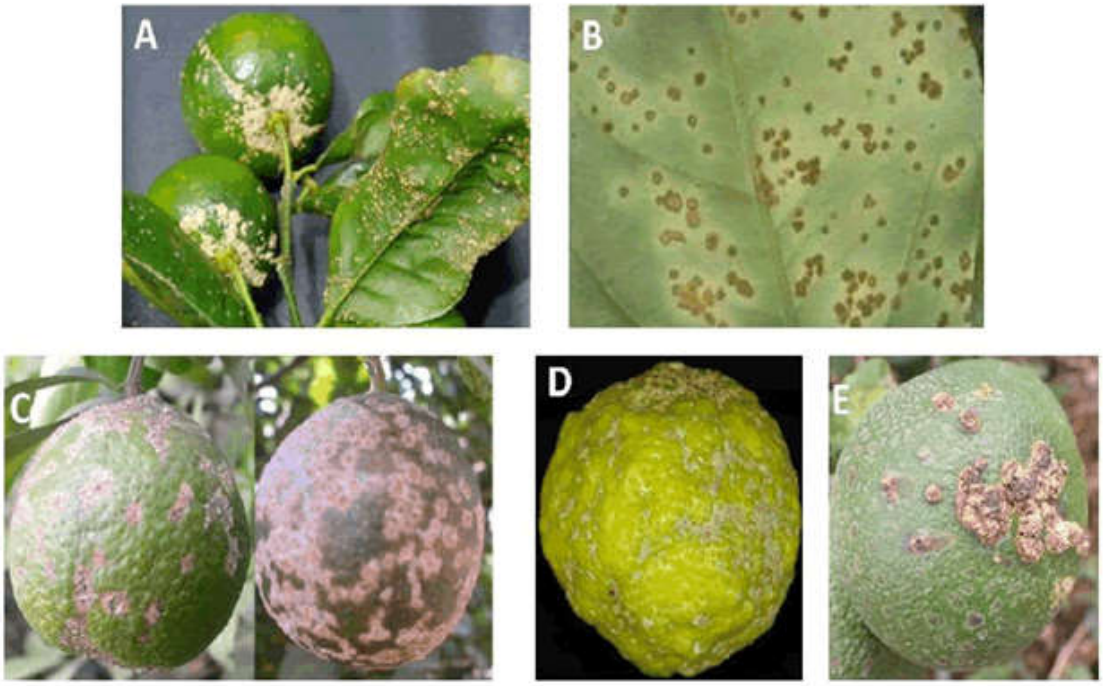
Where, C = Number of diseased fruits in Control, T = Number of diseased fruits in Treatment.

RESULTS

During 2011-12the results showed that Hexaconazole (0.2%) + Streptocycline (100ppm) (T_3) was found effective and significantly superior over all other treatments which recorded 1.02% disease incidence compared to control (11.15%). Other treatments were on par with each other. Similar trend was observed during 2012-13, Hexaconazole (0.2%) + Streptocycline (100ppm) (T_3) was found effective and significantly superior over all other treatments which recorded 1.6% disease incidence compared to control (23.1%). Other treatments were on par with each other. During 2013-14 the results revealed that Hexaconazole (0.2%)+ Streptocycline (100ppm) (T_3) found significantly superior over all other treatments which recorded 8.08% incidence and followed by follower by Carbendazim (0.1%)+ Streptocycline (100ppm) (T2) , Calixin(0.1%) + Streptocycline (100ppm) (T1), Mancozeb (0.3%) + Streptocycline (100ppm) (T4) and T5 (Copper oxychloride (0.3%)+Streptocycline (100ppm)) with 11.32%, 13.06%, 19.63% and 22.88% disease incidence .In T_6 (control) disease incidence was as high as 28.72% (Table 1). Pooled data of three consecutive years revealed that Hexaconazole (0.2%)+ Streptocycline (100ppm) (T3) significantly superior over the other tréatments with highest cost benefit ratio 1: 2.55. (Fig.2)

Table 1. Management of sweet orange scab caused by *Elsinoefawcettii in vivo* using different fungicides during 2011-12, 2012-13 & 2013-14

Treatments	2011-12		2012-13		2013-14		Pooled data		CB ratio
	% Incidence	% disease reduction over control	% Incidence	% disease reduction over control	% Incidence	% disease reduction over control	% Incidence	% disease reduction over control	
T_1:Calixin(0.1%)+Streptocycline (100ppm)	14.3	55.7	5.5	76.2	13.06	54.5	10.95 [b]	60.9	1.65
T_2 :Carbendazim(0.1%)+ Streptocycline (100ppm)	15.2	52.9	7.1	69.3	11.32	60.6	11.21 [b]	60.0	2.16
T_3 :Hexaconazole(0.2%)+ Streptocycline (100ppm)	6.8	78.9	1.6	93.1	08.08	71.9	5.49 [a]	80.4	2.55
T_4 :Mancozeb (0.3%)+Streptocycline (100ppm)	31.3	3.1	15.3	33.8	19.63	31.7	22.08 [c]	21.3	1.62
T_5:Copperoxychloride(0.3%)+ Streptocycline (100ppm)	22.1	31.6	11.8	48.9	22.88	20.3	18.93[c]	32.5	1.86
T_6: Untreated	32.3	0.0	23.1	0.0	28.72	0.0	28.04[d]	0.0	1.15
CD	6.7		3.9		1.948		4.979		
CV%	17.66		24.2		7.040		16.362		



Figue 1. Scab symptoms on (A) Leaves and fruits of Tangerine (B) Close view of scab pustule on lower side of leaf (C) Scab pustule (late infection) on Rangpurlime matured fruit (D) scab pustule on Roughlemon (E)

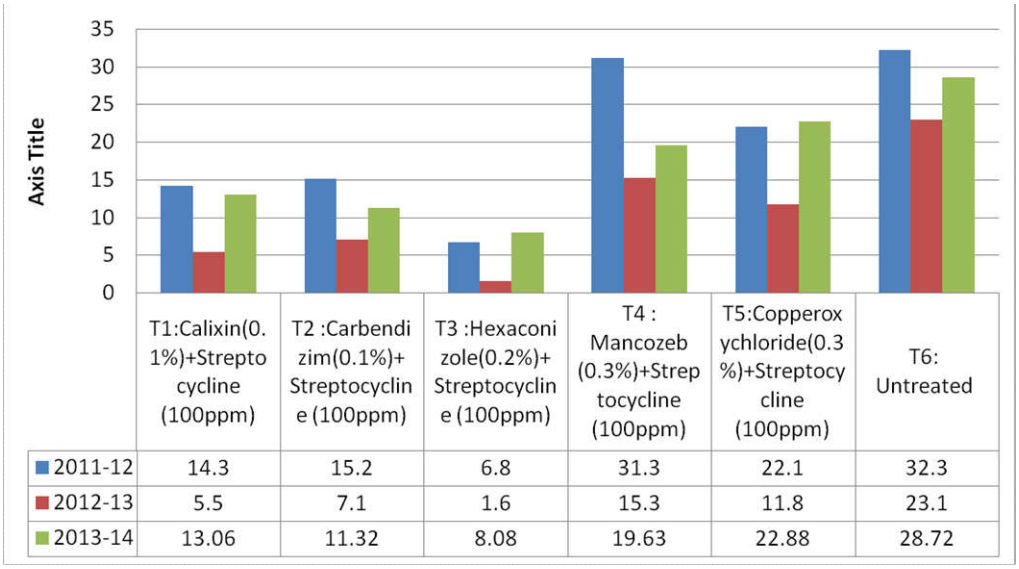


Fig. 2. Effect of different fungicidal treatments on sweet orange scab caused by *Elsinoë fawcettii*

DISCUSSION

The results revealed that across three years Hexaconazole (0.2%)+ Streptocycline (100ppm) (T3) found significantly superior over other treatments. Several workers tested different fungicides. Whiteside (1975) screened different fungicides under field conditions and found that Topsin- M 70 WP @ 2.0 Ib / 100 gallon was effective. Das and Dubey (1988) studied the efficacy of four fungicides *viz*., Captafol, Chlorothalonil, Bordeaux mixture and Copper oxychloride against citrus scab on khasi mandarin under field conditions and observed that the best management for scab was with Captafol (0.2) when sprayed thrice at monthly intervals starting from petal fall followed by Chlorothalonil @ 0.2%, Bordeaux mixture (1.0%), and Copper oxychloride (0.2%). Further, Tripathi and Srivastava (1989) compared the relative efficacy of eleven fungicides and found that Benomyl and Carbendazim both @ 0.1% prevented (79.09% and 75.91%) infection of pathogen on rangpur lime seedlings when sprayed at 30 day intervals. Thind *et at*. (1993) tested ten fungicides, *viz*. Bavistin (0.1%), Baycor (0.1%), Blue copper (0.3%), Bordeaux mixture (0.8%), Cuman-L (0.3%), Dithane M-45 (0.3), Foltaf (0.3%), Stein (0.1%), Topsin-M (0.1%), and Ziram (0.1%) against citrus scab on leaves of rough lemon under field conditions and found that per cent disease control was 64.8% followed by Foltaf @ 0.3%, 62.9% with Ziram @ 0.10%, and 59.8% with Bordeaux mixture @ 0.8% when compared to untreated check. Singh *et al*. (2000) reported that Blitox 50 @ 0.3%, Bordeaux mixture @ 1%, Derosal @ 0.2%, Chlorothalonil @ 0.2% and Indofll M-45 @ 0.3% reduced the disease incidence in the field by 47.8%, 69.5%, 46.2%, 50.4% and 40.4% over control, respectively.

REFERENCES

CABI. 2010. *Elsinoë australis*. Crop Protection Compendium report - *Elsinoë australis* (citrus scab).

Daljeet Singh, S., Kapur and kuldip singh. 2000. Management of citrus scab caused by *Elsinoe fawcettiii. Indian Phytopathology,* 53 (4) : 461-467.

Das, B.C. and Dubey, L.N. 1988. Effect of different fungicides on the incidence of scab in khasi mandarin. *Indian journal of mycology and plant Pathology.* 18: 192.

Hernández, A. G. and M. A. S. Mendes. 2003. Elsinonoe australis. *Ministério da Agricultura, Pecuária e Abastecimento* (MAPA).

Kunta, M., Palm, M., Rascoe, J., de Sa, P. B., Timmer, L. W., da Graça, J. V., Mangan, R. L., Malik, N. S. A., Salas, B., Satpute, A., Sétamou, M. and Skaria, M. 2013. Sweet Orange Scab with a new scab disease "syndrome" of citrus in the U.S.A. associated with *Elsinoë australis*. *Tropical Plant Pathology* vol. 38, pp. 203-212.

Kuang-Ren Chung. 2010, *Elsinoë fawcettii* and *Elsinoë australis*: the fungal pathogens causing citrus scab. *Molecular plant pathology*, 12 (2): 123-135.

Naga Lakshmi,T, Gopi, V, Gouri Sankar, T, Sarada, G, Mukunda Lakshmi, L, Ramana, K.T.V and Gopal, K. 2014.Status of Diseases in Sweet Orange and Acid Lime Orchards in Andhra Pradesh, India. *International Journal of Current Microbiology and Applied Sciences*. 3(5): 513-518.

National Horticulture Board Data base. 2014. www.nhb.gov.in

Siddiquee, T.A., Islam, M.R., Aminuzzaman, F.M., Faruq, A.N. and Islam, M.M. 2011. Efficacy of foliar spray with seven fungicides and a botanical to control scab *(Elsinoe fawcettii)* and dieback *(Colletotrichum gloeosporioides)* diseases of lemon. *The Agriculturists*. 9(1&2): 99-105.

Spósitoa, M. B., Amorimb, L., Bassanezia, R. B., Yamamotoa, P.T., Felippea, M. R. and Czermainski, A.B.C. 2011. Relative importance of inoculum sources of *Guignardia citricarpa* on the citrus black spot epidemic in Brazil'', *Crop Protection* 30, 1546-1552.

Stapleton, A. E. and Walbot, V. 1994. Flavonoids can protect maize DNA from the induction of ultraviolet radiation damage''. *Plant Physiology*, 105, 881–889.

Thind, S.K., M0IIg8, P.K., Sharma, J.N. and Chohan, G.S. 1993. Screening of citrus rootstocks for scab and its control. *Indian journal of Horticulture,* 50: 49-52.

Timmer, L.W. 1999. Diseases of fruit and foliage''. In: Citrus Health Management (L.W. Timmer, L.W. Duncan, eds.), APS Press, St. Paul, MN, USA, pp. 107–115.

Timmer, L.W., Garnsey, S. M. and Graham, J.H. 2000 Compendium of Citrus Diseases, APS Press, St Paul, MN.

Wheeler, B. E. 1969. *An Introduction to Plant Diseases*, John Wiley and Sons Ltd, London, UK. pp. 43-46.

Whiteside, J.O. 1975. Evaluation of fungicides for citrus scab control. *Proc. Fla. St. Hort. Soc.,* 87: 9-14.

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