International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(6): 2078-2083

Received: 11-09-2018
Accepted: 15-10-2018

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Pathological survey of green mould rot of Kinnow in various fruits markets and citrus growing regions of Himachal Pradesh

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Abstract
Kinnow is the most important fruit crop grown extensively in sub-tropical areas of Himachal Pradesh. Among different fungal post-harvest rots in Kinnow, green mould caused by *Penicillium digitatum* is most serious. Symptoms of the disease appeared initially as **s**oft, watery and slightly discoloured spots on the surface of fruit rind. During the survey of the disease, incidence of green mould rot ranged between 16.5 to 27.0 per cent recorded. Average severity of disease was recorded maximum in Paonta Sahib (21.33%). While, fruit marketing yard at Theog and Dhalli had lower severity of 13.70 and 15.73 per cent, respectively.

Keywords: citrus, green mould, incidence, severity, kinnow

Introduction
Citrus (*Citrus* spp.) is one of the major fruit crop which primarily includes lime, lemon, orange, tangerine, mandarins and Kinnow etc and these are commercially grown in 137 countries with particular tropical and sub-tropical agro-climatic conditions (Ismail and Zhang, 2004). In India, citrus is cultivated over an area of near about 10.7 lakh hectare with total annual production of 111.4 lakh tones and possesses third position in production with global share of 4.8 per cent (Anonymous, 2015) [15]. In India, important citrus growing states are Maharashtra, Andhra Pradesh, Punjab, Karnataka, Uttrakhand, Bihar, Orissa, Assam and Gujarat. Whereas, productivity of citrus in India is low (9.35 t/ha) in comparison to the other developed countries like Brazil, USA, China, Mexico and Spain which are having productivity of 30-40 t/ha. In Himachal Pradesh, productivity is still low only 0.65 t/ha in comparison to Karnataka (21.98 t/ha), Punjab (20.31 t/ha) and Madhya Pradesh (17.28 t/ha) (Anonymous, 2014) [14]. There were several reasons for the low productivity of citrus like lack of nutrition, poor management practices and infestation of several pest and diseases. Citrus is infected by many pathogens like fungi, bacteria and viruses which resulted huge economic losses. Important fungal diseases in citrus fruits are gummosis (*Phytophthora citrophthora* and *P. parasitica*), anthracnose (*Colletotrichum gloeosporioides*), Alternaria brown spot (*Alternaria alternata*), citrus scab disease (*Elsinoe fawcettii*) and melanose (*Diaporthe citri*). Among bacterial diseases, important diseases are citrus canker caused by *Xanthomonas axonopodis* pathovar *citri* and citrus greening caused by *Candidatus liberibacter asiaticus.* Among virus disease, *Citrus tristeza virus* is important and *Citrus exocortis viroid* is important viroid disease. Among fungal diseases, post-harvest diseases are also important which results in significant losses. Many pathogens are reported to be associated with post-harvest fungal diseases which drastically reduced yield and quality of citrus (Barkai-Golan, 2001, Plaza *et al*. 2003) [4, 5]. Important post-harvest pathogens infecting citrus fruits include *Penicillium digitatum* Sacc and *P. italicum* Wehmer, *Botrytis cinerea*, *Alternaria citri*, *Colletotrichum gloeosporioides*, *Aspergillus Niger*, *Phytophthora parasitica*, *Diplodia natalensis*, *Geotrichum candidum* and *Trichoderma viride* (Whiteside *et al*. 1988) [30]. In developing countries, lack of proper handling of freshly harvested fruit resulted huge losses during transport and storage which exceed sometimes more than 50 per cent (Wisniewski and Wilson, 1992) [31]. Among post-harvest diseases of citrus, green mould (*Penicillium digitatum*) and blue mould (*P. italicum*) are most commonly observed in all citrus growing areas throughout the world (Palou *et al*. 2001, Skaria *et al*. 2003, Plaza *et al*. 2004) [18, 21]. Infection of these moulds usually

resulted from infection of wound made on citrus fruit surface during harvesting, handling and processing. As incidence and severity are the tool to measure the disease prevalence. Hence, the present study was conducted to survey the information on disease incidence and severity of green mould of citrus (Kinnow) in major fruit terminal markets and fruit growing areas of Himachal Pradesh.

Material and Methods

Survey and collection of diseased samples

Periodic surveys of marketing yards, local markets and fruit vendors in the district of Shimla, Sirmour, Una and Kangra district of Himachal Pradesh were done to record the incidence of green mould and other rots (blue mould and anthracnose) in Kinnow fruits during November to February during 2014-2016. In each month, two visits were made and 200 fruits were observed at atleast 5 outlets of sale at each location for recording the incidence of above mentioned diseases. To study the prevalence of the disease, 39 locations of various terminal and local fruit markets as well as prominent fruit vendors were surveyed during the peak harvesting season of Kinnow in the months of November to February in 2014, 2015 and 2016. Surveys were majorly focused in major Kinnow growing districts viz. Kangra, Una, Sirmour, Solan and Shimla. The study to record the incidence was based on visual symptoms of the disease which were later confirmed by the isolation of the pathogen from representative samples of the diseased fruits. Sampling of the fruits for recording disease incidence was done randomly from each location. Beside this, data was recorded by taking fruit samples from different packaging material commonly used by the farmers like rectangular plastic fruit crates, loose gunny bags as well as from the open heaps kept for selling on roadsides (Fig. 4). Kinnow fruits showing green mould (*P. digitatum*) symptoms were counted and per cent disease incidence was calculated. Data pertaining to the incidence of green mould (*P. digitatum*) disease of Kinnow is presented in Table 1.

Per cent disease incidence of green mould and other rots was calculated by formula given below:

$$\text{Disease incidence (\%)} = \frac{\text{Number of Kinnow fruits with green mould symptoms}}{\text{Total number of Kinnow fruits observed}} \times 100$$

Fruits were randomly selected at each location. To record the disease severity on the fruits, 0-5 disease rating scale was used to assess the losses in fruits (Fallik *et al*.1993, Verma, 2008) [29, 11].

Grade	Scale
0	No disease
1	1/5th of fruit area infected
2	2/5th of fruit area infected
3	3/5th of fruit area infected
4	4/5th of fruit area infected
5	Whole fruit area infected

Per cent disease index was calculated by adopting the formula devised by McKinney (1923).

$$\text{Disease index (\%)} = \frac{\text{Sum of all numerical ratings}}{\text{Number of fruit samples observed} \times \text{maximum disease rating}} \times 100$$

During the course of the survey, green mould infected fruits were collected in separate paper bags from the surveyed areas and brought to the laboratory for the isolation and confirmation of the associated pathogen. Association of pathogen of green mould and pathogens of other fruit rots was confirmed by matching with the standard symptoms cited in the literature and also by microscopic examination of the pathogen. These diseased samples were stored in the refrigerator at 5^{o}C temperature for further studies.

Result and Discussion

It is evident from the data (Table 1.) that the green mould disease of citrus was widespread at all the locations in Kangra, Solan, Una and Sirmour districts of Himachal Pradesh (Fig. 1, 2 and 3). During the course of the surveys, typical symptoms of the green mould disease in Kinnow were observed on the surface of the fruits at different places. The initial symptoms of disease appeared at a place with injury to the skin of the fruit. Soft, watery and slightly discoloured spots (5-13 mm in diameter) were produced on the surface of fruit rind. These lesions further got enlarged to 2-4 cm in diameter within few hours at room temperature and fungus got penetrated easily into the juice vesicles of fruit. Later on, white mycelial growth of fungus appeared and cover the entire fruit surface followed by the development of olive-green powdery spore mass. Spores of the fungi were produced in chains in large quantities on infected fruits. The fungus survives as spores in site of injury on fallen fruits as well as in soil of the orchard. In later stages, tissues of entire fruit get disintegrated and collapsed into a soft decomposing mass. The data indicated that overall incidence of green mould ranged between 16.5 to 27.0 per cent during 2014, 2015 and 2016. Incidence of other rots (anthracnose and blue mould) in Kinnow fruits ranged between 13.9 to 17.0 per cent during these three years. There was not much variation in different years. In 2014, highest incidence (25.5%) of green mould was recorded at Dhaulakuan followed by Paonta Sahib (24.5%), Nurpur (24.5%) and Santokhgarh (24.5 %) with lowest incidence of 16.5 per cent at Theog. In 2015, maximum incidence (27.0%) of green mould was recorded at Paonta Sahib which is followed by Dhaulakuan (26.5%), Jachh (26.0%), Nurpur (25.5%), Mubarkpur (25.5%), Satonkhgarh (25.5%) and Runpat (25.5%) with lowest incidence of 19.5 per cent recorded at Theog. Further, in 2016, highest green mould incidence of 25.5 per cent was recorded at Jachh, Bassa-Bajira, and Paonta Sahib locations while locations like Dhaulakuan, Mubarkpur, Salyali and Indpur had incidence of 25.0 per cent. Lowest incidence of 18.0 per cent of green mould was recorded at Theog. Overall average highest incidence of green mould of 25.6 per cent was recorded at Paonta Sahib and Dhaulakuan followed by Santokhgarh (24.8%), Mubarkpur and Jachh with 24.6 per cent incidence. Fruit marketing yard and fruit vendors at Theog and Dhalli had overall lower incidence of 18.0 to 19.6 per cent during the three years. Overall data indicated that the incidence of green mould was higher in those locations which were located at lower elevations of tropical and sub-tropical regions in comparison to locations located at higher elevations with comparatively cooler climatic conditions. There are many reports in the literature which indicated the association of *Penicillium* spp. and *Aspergillus* spp. as the dominant post-harvest pathogens of Kinnow and other citrus fruits. The association of different fungal pathogens like *P. italicum, P. digitatum, A. niger, Geotrichum* spp. and *Fusarium* spp. responsible for decay during storage in Himachal Pradesh (Kaul and Lall, 1975) [13]. Post-harvest rotting due to blue, green and grey mould diseases has been reported as the

prominent cause, out of which *Penicillium* spp. was reported to be most important fungal pathogen causing severe damage to citrus fruits (Singh *et al*. 2003, Plaza *et al*. 2004) [7, 20]. The symptoms recorded in the present study are very much similar to the earlier reports by different researchers (Klotz and Harding, 1970 [16], Snowdon 1990 [28], Brown and Eckert 2000, Chand, 2013) [10, 7]. It has been reported that during long storage, infected fruits lose their compactness and get decayed more rapidly than fresh fruits within five to ten days (Kavanagh and Wood, 1967). *P. digitaum* is a necrotrophic pathogen and produce hydrolytic enzymes like polygalacturonases and cellulases which result in the maceration of the tissue during disease development (Eckert and Eaks, 1989, Barkai-Golan and Karadavid, 1991) [6, 5]. About, 18.5-25.9 per cent incidence of green mould of Kinnow in Solan, Kangra and Sirmour district of Himachal Pradesh with 25.9 per cent incidence at Paonta Sahib in district Sirmour (Sharma and Prashad, 2015). In Punjab, Kaur and Verma (2002) [14] observed 58.3 per cent incidence of green mould of Kinnow caused by *P. digitatum*. The extent of loss in local mandarin ranged between 15.1 to 22.1 per cent and spoilage due to green mould ranged from 8.5 to 12.0 per cent (Prabhakar *et al*. 2004) [22]. About, 5.1 to 8.8 per cent incidence of green mould of Kinnow mandarin in fruit markets of Jammu (Verma, 2008) [29]. *P. digitatum* was found as major post-harvest pathogen in Andhra Pradesh, which caused 26.2 and 20.4 per cent rotting incidence in oranges as well as in acid lime, respectively (Reddy *et al*., 2008) [23]. 6.0 per cent rotting of Kinnow fruits was observed to be caused by various pathogens including *P. digitatum* in retail fruit market of Sriganganagar (Sharma *et al*. 2010) [24]. 17.6 to 48.6 per cent incidence of the grey mould in mandarin orange caused by *P. digitaum* was recorded in different wholesale and retail fruit market of Madhya Pradesh (Dhakad, 2015) [9]. Data on severity of green mould disease was recorded by taking fruits samples from major terminal and local fruit markets including fruit vendors of major Kinnow growing districts viz. Kangra, Una, Sirmour, Solan and Shimla during 2014, 2015 and 2016. Average severity of disease was recorded maximum in Paonta Sahib (21.33%) followed by Dhaulakuan (20.83%), Jachh (19.87%) and Santokhgarh (19.73%). Fruit marketing yard at Theog and Dhalli had lower severity of 13.70 and 15.73 per cent, respectively. Data on disease severity indicate that severity of the disease was higher in lower elevation with warmer climate and severity was lower in higher elevation. About, 9.0 to 14.0 per cent average disease severity caused by green mould was recorded in sweet oranges (Reddy *et al*. 2008) [8]. About, 49.63 per cent average disease severity caused by *P. digitatum* in Kinnow fruits under ambient storage condition (Alam *et al*. 2016) [1]. 20.0 per cent disease severity of citrus green mould was recorded in local fruit market of Tamil Nadu (Patil *et al*. 2017) [19]. Similar observation of higher incidence and severity of green mould has been reported in fruit markets located in tropical conditions (Cunningham and Taverner, 2007, Smilanick and Sorenson, 2001) [8, 27]. Therefore, the results of present studies exhibited the fact that incidence and severity of green mould rot on Kinnow fruits differ at the various locations of Himachal Pradesh.

Table 1: Incidence of post-harvest rots in Kinnow at important terminal and local fruit markets including fruit vendors of Himachal Pradesh

District	Terminal/ local fruit market/fruit vendor	Incidence (%) of post-harvest rots in Kinnow							
		2014		2015		2016		Mean	
		Green mould	Other rots	Green mould	Other rots	Green mould	Other rots	Green mould	Other rots
Shimla	Dhalli	18.5	13.9	21.0	14.0	19.5	14.4	19.67	14.10
	Theog	16.5	14.8	19.5	15.5	18.0	13.6	18.00	14.63
Solan	Parwanoo	22.5	15.3	24.0	15.7	21.5	15.0	22.67	15.33
	Nalagarh	23.0	16.3	24.5	15.6	22.5	14.6	23.33	15.50
	Solan fruit market	19.5	15.0	22.0	15.3	20.5	14.6	20.67	14.97
Kangra	Bassa – Bajira	20.0	14.6	25.0	16.3	25.0	15.1	23.3	15.33
	Jachh	22.5	16.1	26.0	16.4	25.5	15.6	24.67	16.0
	Raje-da-talah	20.5	14.0	23.0	15.5	21.5	14.6	21.67	14.70
	Gangat	22.5	14.5	24.5	15.7	22.5	15.3	23.17	15.17
	Indpur	22.0	15.3	23.5	15.3	22.5	15.3	22.67	15.30
	Salayali	22.5	14.8	25.0	16.0	24.0	15.5	23.83	15.43
	Bhadwar	21.5	14.0	24.0	15.9	22.0	15.0	22.50	14.97
	Rehan	22.5	15.0	23.5	15.6	22.0	14.6	22.67	15.07
	Dehra	20.5	15.3	23.0	15.6	22.5	15.2	22.00	15.37
	Nurpur	24.0	16.0	25.5	15.8	23.5	15.3	24.33	15.7
	Indora	23.5	15.3	24.0	16.4	24.0	15.2	23.83	15.63
Una	Basal	21.5	15.5	22.5	16.0	19.5	14.9	21.17	15.47
	Amb	24.0	15.0	24.0	15.8	22.5	15.4	23.50	15.40
	Mubarkpur	23.5	14.6	25.5	16.2	25.0	15.3	24.67	15.37
	Badhera	22.5	15.7	24.5	16.3	24.5	14.7	23.83	15.57
	Karampur	20.5	14.8	23.0	15.8	22.5	16.0	22.00	15.53
	Laldi	21.0	15.2	23.5	15.3	23.5	15.4	22.67	15.30
	Khad Pinjore	21.5	14.9	22.5	15.8	19.5	15.3	21.17	15.33
	Santokhgarh	24.5	15.4	25.5	16.2	24.5	15.4	24.83	15.67
	Polian	19.5	15.3	20.5	14.9	19.0	15.3	19.67	15.17
	Nangal Jariala	20.5	14.5	22.5	14.7	20.5	15.3	21.17	14.83
	Ghanari	22.5	15.4	24.5	16.0	24.5	15.4	23.83	15.60
Sirmour	Dhaulakuan	25.5	16.3	26.5	17.0	25.0	15.5	25.67	16.26
	Nahan	20.0	14.8	22.5	15.6	20.5	15.9	21.00	15.43
	Kolar	20.5	15.5	22.5	15.3	20.0	15.2	21.00	15.33
	Senwala	22.5	15.4	23.5	15.4	22.0	14.9	22.67	15.23
	Tokyo	19.0	14.5	19.5	15.4	20.5	15.4	19.67	15.10
	Runpat	23.5	15.2	25.5	16.0	24.5	15.3	24.50	15.5

	Bhedewala	19.5	15.3	20.5	15.2	19.0	15.4	19.67	15.30
	Paonta Sahib	24.5	15.8	27.0	16.3	25.5	16.2	25.67	16.1
	Bharapur	20.0	14.8	22.5	15.4	19.5	14.5	20.67	14.90
	Purwala	20.0	15.3	22.5	15.3	19.5	15.4	20.67	15.33
	Shambhuwala	22.0	15.5	23.5	15.4	23.0	14.6	22.83	15.17
	Manjira	20.5	14.5	22.5	15.3	19.5	15.1	20.83	14.97

Table 2: Severity of green mould of Kinnow fruits at important terminal and local fruit markets including fruit vendors of Himachal Pradesh from 2014 to 2016

District	Terminal/ local fruit market	Per cent disease index (%) of green mould of Kinnow fruit during the year 2014 to 2016			
		2014	2015	2016	Mean
Shimla	Dhalli	14.7	15.3	15.4	15.13
	Theog	11.8	14.5	14.8	13.70
Solan	Parwanoo	16.3	18.2	18.2	17.57
	Nalagarh	16.5	19.3	18.9	18.23
	Solan fruit market	15.4	17.5	17	16.63
Kangra	Bassa – Bajira	17.8	20.4	20.4	19.53
	Jachh	17	21.8	20.8	19.87
	Raje-da-talah	16.1	17.9	18.4	17.47
	Gangat	18.4	20.1	17.5	18.67
	Indpur	18.5	18.6	17.3	18.13
	Salayali	18.3	20.6	20.2	19.70
	Bhadwar	15.6	18.4	18.2	17.40
	Rehan	16.2	17.4	18.0	7.20
	Dehra	16.4	17.5	18.2	17.37
	Nurpur	20.8	18.7	19.5	19.67
	Indora	19.0	19.7	19.6	19.43
Una	Basal	17.5	17.1	16.1	16.90
	Amb	19.5	18.6	18.7	18.93
	Mubarkpur	18.9	19.7	20.5	19.70
	Badhera	18.8	20	20	19.60
	Karampur	16.9	17.6	18.0	17.50
	Laldi	16.2	18.3	18.7	17.73
	Khad Pinjore	18.5	17.8	16.8	17.70
	Santokhgarh	20.6	19.1	19.5	19.73
	Polian	15.7	16.9	16.4	16.33
	Nangal Jariala	19	18.2	17.3	18.17
	Ghanari	18	20	19.7	19.23
Sirmour	Dhaulakuan	21.9	21.1	19.5	20.83
	Nahan	17.1	17.1	17	17.07
	Kolar	15.5	19.2	16.4	17.03
	Senwala	17.2	19.3	18.2	18.23
	Tokyo	15.4	16.4	17.6	16.47
	Runpat	19.3	20.8	19.4	19.83
	Bhedewala	16	16.9	15.5	16.13
	Paonta Sahib	21.0	22.0	21.0	21.33
	Bharapur	16	17.1	16.3	16.47
	Purwala	16.8	17.8	15.4	16.67
	Shambhuwala	18.2	19.2	18.9	18.77
	Manjira	17.7	18	16.4	17.37

Fig.1 Fruit Marketing Yard

Fig.2. Post-harvest losses due to fungal pathogens

Fig.3. Green Mould of Kinnow (*Penicillium digitatum*)

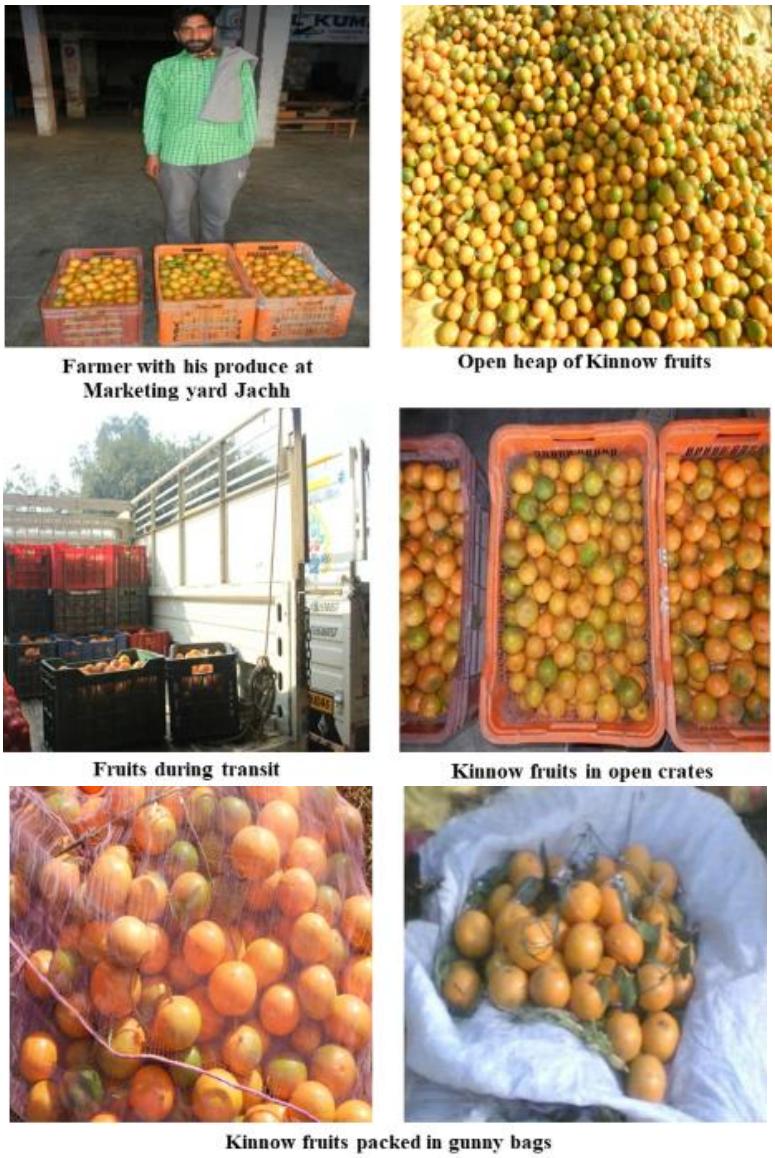

Fig 4: Kinnow fruits in different packing modes

References

1. Alam MW, Rehman A, Ali S, Fiaz M, Riaz K. Assessment of different food additives for postharvest disease control of kinnow mandarin fruit. Transylvanian Review. 2016; 24(10):1934-1951.
2. Anonymous. 2014. http://www.nhb.gov.in
3. Anonymous. 2015. http://www.nhb.gov.in
4. Barkai-Golan R. Postharvest Diseases of Fruits and Vegetables: Development and Control. Elsevier Science, Amsterdam, Netherlands, 2001, 418.
5. Barkai-Golan R, Karadavid R. Cellulolytic activity of *Penicillium digitatum* and *P. italicum* related to fungal growth and to pathogenesis in citrus fruits. Journal of Phytopathology. 1991; 131:65-72.
6. Brown GE, Eckert JW. Diplodia stem-end rot. In: Compendium of citrus diseases 2nd edition. LW Timmer, SM Garnsey and JH Graham (Eds.). American Phytopathological Society, St. Paul, Minnesota, 2000, 43-44.
7. Chand P. Studies on etiology and management of green mould rot of citrus, M.Sc (Ag.) Thesis. Department of Plant Pathology, Dr Yashwant Singh Parmar University of Horticulture and Forestry, Solan, India, 2013, 67.

8. Cunningham NM, Taverner PD. Efficacy of integrated postharvest treatments against mixed innoculations of *Penicillium digitatum* and *Geotrichum citri-aurantii* in 'leng' navel oranges (*Citrus sinensis*). New Zealand Journal of Crop and Horticultural Science. 2007; 35(2):187-192.
9. Dhakad B. Studies on post-harvest decay of mandarin orange (*Citrus reticulate* Blanco.) due to grey mould (*Penicillium digitatum* Sacc.) and its management. M.Sc (Ag.) Thesis, (Plant Pathology). Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior College of Agriculture, Indore, Madhya Pradesh, 2015, 81.
10. Eckert JW, Eaks IL. Postharvest disorders and diseases of citrus fruits. In: *The Citrus Industry*. W Reuther, EC Calavan and GE Carman (Eds.). University of California Press. Oakland. USA. 1989, 179-260.
11. Fallik E, Klein JD, Grinberg S, Lomaniec E, Lurie S, Lalazar A. Effect of postharvest heat treatment of tomatoes on fruit ripening and decay caused by Botrytis cinerea. Plant Disease. 1993; 77:985-988.
12. Ismail M, Zhang J. Post-harvest citrus diseases and their control. Outlooks on Pest Management. 2004; 15:29-35.
13. Kaul JL, Lall BS. Post-harvest fungal diseases of citrus in Himachal Pradesh. Indian Phytopathology. 1975; 28(1):119-121.
14. Kaur P, Verma KS. Prevalence of post-harvest rots of Kinnow in Punjab. Plant Disease Research. 2002; 17(2):329-331.
15. Kavanagh JA, Wood RKS. The role of wounds in the infection of orange by *Penicillium digitatum*. Annals of Applied Biology. 1967; 60:375-383.
16. Klotz LJ, Harding PR. Control of post-harvest dexcay in citrus fruits. *California Citrography*. 1970; 55:261-62.
17. Mckinney HH. Influence of soil temperature and moisture on infection of wheat seedlings by *Helminthosporium sativum*. Journal of Agricultural Research. 1923; 26:195- 217.
18. Palou L, Smilanick JL, Usall J, Vinas I. Control of postharvest decay blue and green molds of oranges by hot water, sodium carbonate and sodium bicarbonate. Plant Disease. 2001; 85:371-376.
19. Patil SR, Parthiban VK, Sekar GR, Marimuthu K. Survey, isolation and Identification of post-harvest Penicillium mould of sweet orange. Journal of Soils and Crops. 2017; 27(1):45-49.
20. Plaza P, Sanbruno A, Usall J, Lamarca N, Torres R, Pons J, *et al*. Integration of curing treatments with decreeing to control the main postharvest diseases of Calementine mandarins. Postharvest Biology and Technology. 2004; 34:29-37.
21. Plaza P, Usall J, Teixide N, Vinas I. Effect of water activity and temperature on germination and growth of *Penicillium digitatum*, *P. italicum* and *Geotrichum candidum*. Journal of Applied Microbiology. 2003; 94:549-554.
22. Prabhakar K, Raguchander T, Parthiban VK, Muthulakshmi P, Prakasam V. Post harvest fungal spoilage in mandarin at different levels of Market. Madras Agricultural Journal. 2004; 91(7-12):470-474.
23. Reddy VB, Madhavi GB, Reddy CV, Reddy CK, Chandrasekhar RM. Post-harvest fungal spoilage in sweet orange (*Citrus sinensis*) and acid lime (*Citrus aurentifolia* Swingla) at different stages of marketing. Agricultural Science Digest. 2008; 28(4):265-267.
24. Sharma RN, Maharshi RP, Gaur RB, Bhati DS. Post-harvest mycobial rots of kinnow fruits (*Citrus deliciosa* Ten.) incidence and economical perspectives. Journal of Global Communication. 2010; 3(2):46-50.
25. Singh D, Thakur RK, Singh D. Effect of pre harvest sprays of fungicides and calcium nitrate on post-harvest rot of kinnow in low temperature storage. Plant Disease Research. 2003;18(1):9-11.
26. Skaria M, Eayre CG, Miao H, Solis GN, Mackey B. Effect of packing on rot and fruit damage in Rio Red grapefruit. Subtropical Plant Science. 2003; 55:75-78.
27. Smilanick JL, Sorenson D. Control of postharvest decay of citrus fruit with calcium polysulfide. Postharvest Biology and Technology. 2001; 21:157-168.
28. Snowdon AL. Citrus Fruits. In: A Color Atlas of Post-Harvest Diseases and Disorders of Fruits and Vegetables. Volume. 1: General Introduction and Fruits. Chemical Rubber Company Press, Boca Raton, Florida, 1990, 70.
29. Verma VS. Seasonal occurrence and chemical management of postharvest fungal rot pathogens of mandarin orange (*Citrus reticulata* Blanco). Indian Phytopathology. 2008; 61(3):317-322.
30. Whiteside JO, Garnsey SM, Timmer LW. (Eds). Compendium of Citrus Diseases (Disease Compendium Series). American Phyto pathological Society, St. Paul, Minnesota, 1988, 80.
31. Wisniewski ME, Wilson CL. Biological control of postharvest diseases of fruits and vegetables: recent advance. Hort Science. 1992; 27:94-98.