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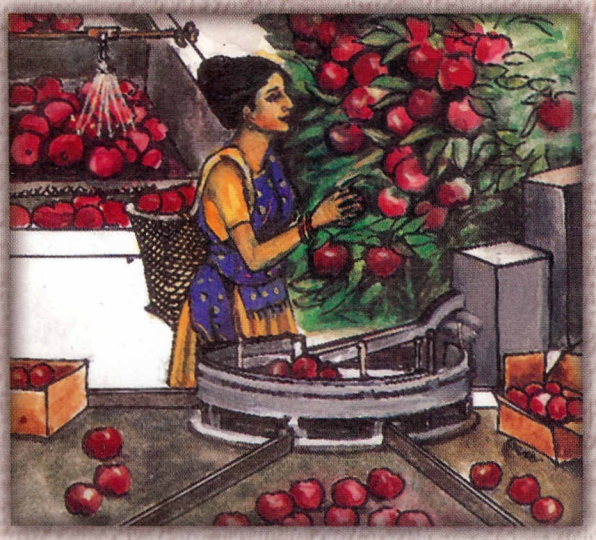

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Postharvest Management in Agriculture
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SAARC Agricultural Information Centre (SAIC)

SAARC Agricultural Information Centre (SAIC)
BARC Complex, Farmgate, Dhaka 1215, Bangladesh

Published : 1995

Cover design : Mafruha Begum

Price : US$ 5.00 for SAARC countries
US$ 8.00 for other countries

Chandel, A S and Kamal, R M
Postharvest Management in Agriculture: SAARC bibliographical database.
Dhaka: SAARC Agricultural Information Centre, 1995.
ii, 231, xxxv p.
1. Postharvest technology, bibliography. 2. SAARC Agricultural Information Centre. i. Jt. Author. ii. Title.

Published by : Director, SAARC Agricultural Information Centre (SAIC)
Printed at : Panir Printers, 9 Nilkhet, Dhaka 1205

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619 VIJAY, S. 1987. **Low cost technology for processing horticulture produce under Indian conditions**. *Bev. Fd. World*, 14: 1, 67.

620 VIJAY, S. 1993. **Prospects and constraint for export of indigenous fruits and vegetables products**. *Indian Food Packer*, 47: 5, 37-44.

APPLES

Postharvest handling

621 BARWAL, VS. 1993. **Effect of harvesting time and handling period on quality of apple**. *Journal of Food Science and Technology - Mysore*, 30: 1, 42-43.

Fruits from 4 promising cultivars (Hardeman', 'Red Spur Delicious', 'Topred' and Vance Delicious) were picked on 3 dates between 110 and 125 days after full bloom and their physical and organoleptic characteristics were studied upto 21 days of handling period under ambient conditions. Harvesting dates had no significant effect on the diameter of fruits of 'Hardeman', 'Red Spur Delicious' and Topred'. There was significant increase in organoleptic acceptability of fruits of all cultivars. Decrease in firmness and physiological weight loss (PWL) was found in late harvesting. During handling, organoleptic acceptability was at par upto 14 days in all the cultivars excepting 'Vance Delicious'.

622 LAL, BB; SHARMA, PC. 1994. **Apples**. *Handbook of World Fruits; Cultivation, Storage and Processing*/edited by DK Salunkhe; SS Kadam. USA: Marcel Deckers.

623 LAL, BB; RANA, RS; KLOCHHAR, HL; CHADHA, TR; MAINI, SB. 1988. **Packaging and transportation of apples a study on commercial aspects**. *Production and Conservation of Forestry*/edited by PK Khosla; DK Khurana; Atul. Solan, (H.P.), India: Indian Society of Tree Sciences, p. 79-86.

624 MAINI, SB; DIWAN, B; LAL, BB; ANAND, JC. 1994. **Post harvest management of apples**. *Indian Horticulture*, 29: 3, 51-54.

625 MAINI, SB; DIWAN, B; LAL, BB; ANAND, JC. 1982. **Studies on packaging, transport and storage of apples in different wooden containers**. *Indian Fd. Packer*, 36: 3, 34-37.

Storage

626 GUPTA, OP; KAUL, RK; HAFIZA. 1989. **Studies on the shelf-life of Kashmir apple cv. Red Delicious in relation to its picking maturity for cold storage**. *Agricultural Science Digest Karnal*, 9: 4, 188-190; 4 ref.

Fruits of Red Delicious were harvested 140, 155 or 170 days after full bloom (on 13 Sep., 28 Sep. and 13 Oct., respectively). They were packed in conventional wooden boxes lined with paper and, within 24 h, placed in a cold store at 0-1°C and 85-90% RH. On 15 Apr. they were removed from storage and transported. After 3, 10, 17 and 24 days at 22.4-36.5° and 52.3% RH (early summer climatic conditions of Jammu) they were assessed for fruit firmness and contents of TSS, total sugars, non-reducing sugars and % acidity. Fruits harvested 140 or 155 days after full bloom maintained their shelf-life and quality for 17-24 days after storage, compared with only 3-10 days for fruits harvested after 170 days.

627 MAHAJA, BVC; CHOPRA, SK. 1992. **Effect of pre-harvest application of ethylene inhibitors on polygalacturonase, cellulase and malic-dehydrogenase enzyme activities of apple during cold storage**. *Indian Journal of Plant Physiology*, 35: 4, 305-310.

628 MAHAJAN, BVC. 1994. **Biochemical and enzymatic changes in apple during cold storage**. *Journal of Food Science and Technology - Mysore*, 31: 2, 142-144.

Biochemical and enzymatic changes in apple during cold storage were studied. Total soluble solids, total sugars and soluble protein contents increased upto 150 days of storage and thereafter declined. In contrast, titratable acidity, total phenols and pectin contents followed a linear declining trend throughout the storage period of 7 months. The activity of polygalacturonase and cellulase increased upto 150 days of storage, thereby leading to softening of apple. The activities of thaw enzymes declined thereafter.

629 MAINI, SB; DIWAN, B; LAL, BB; ANAND, JC. 1985. **Fruit firmness as a simple index of quality of stored apples**. *Indian J. Agric. Sci.*, 55: 1, 60-61.

630 MAINI, SB; DIWAN, B; LAL, BB; ANAND, JC. 1985. **Physicochemical characteristics in relation to market quality of apples during storage**. *Indian Fd. Packer*, 39: 1, 51-54.

631 PRAKASH, MS; NARASIMHAM, P; DHANARAJ, S; ARVINDAPRASAD, B; PRASAD, CAK; HABIBUNNISA; ANANTHAKRISHNA, SM. 1988. **Studies on maturation of apples: effect of seasonal variation on physico-chemical parameters and their correlations**. *Journal of Food Science and Technology Mysore*, 25: 4, 205-210; 15 ref.

Fruit growth and maturity patterns were studied during 4 consecutive seasons (1973-76) in the cultivars Royal Delicious, Red Delicious, Richared and Golden Delicious. The trees were about 20 years old, growing in a commercial orchard 2270 m a.s.l. in the Simla hills. All the physical and chemical maturity parameters showed clear changes during maturation, with seasonal variations. The data are tabulated and graphically presented. Limits for different parameters (% TSS, % acidity, fruit diameter, fruit weight, and the Magness-Taylor puncture values for firmness) at optimum maturity are shown for each cultivar and season. Fruits of Red Delicious harvested at optimum maturity (a starch pattern index of around 4) and held at 32°F and 90% RH for 3-5 months showed good quality and storability.

632 SIDDIQUI, S; BANGERTH, F. 1993. **Studies on cell wall mediated changes during storage of calcium-infiltrated apples**. *International Symposium on Pre- and Postharvest Physiology of Pome-fruit*. (Sint-Truiden (Belgium): 1992: 9-13 Jun)/edited by R Marcelle. Wageningen (Netherlands): International Society for Horticultural Science (ISHS), Wageningen (Netherlands) p. 105-113.

633 THAKUR, K.S. 1989. **Effect of time of picking, and some chemical treatments on the biochemical constituents and storage of apple (*Malus domestica Borkh*) cv. royal delicious (Ph.D : thesis)**. Dr. Y.S. Parmar University of Horticulture & Forestry, Solan, Himachal Pradesh. 180 Pages.

The present studies were conducted to determine the optimum time of harvest of some commercial apple cultivars of Himachal Pradesh and also to ascertain the effects of various pre-harvest treatments on fruit quality of Royal Delicious apples at harvest and after storage at 0+1°C. The results indicated that harvesting of Royal Delicious, Red Delicious/Richared and Golden Delicious fruits should be done between 19 and 24 August, 26 and 31 August, and 5 and 10 September, respectively. At optimum maturity, fruit size, weight, firmness and TSS content in the red strains and golden delicious should be around 5.75 X 6.45, 170 g, 75 N and 12% respectively, and 5.60 X 6.35, 170 g, 75 N and 14% respectively. At this time, the starch-iodine test showed disappearance of starch in about 50% cross-sectional area of the fruit. Fruits harvested on the above dates scored highest numerical ratings for organoleptic tests after storage. The application of alar (500 and 1000 ppm) and CaCl2 prior to ethephon treatment (500 and 1000 ppm) was effective in reducing the detrimental effects of the latter on the storage quality of Royal delicious fruit. Physiological weight loss during storage and decrease on firmness in response to ethephon treatments were countered effectively by pre-treatments of alar and CaCl2. Fruit respiration rates at harvest, contents of TSS titratable acidity, sugars, starch, pectin, phenol, soluble proteins and the activities of various enzymes were lower, whereas fruit calcium content was higher in fruits treated with all the three substances as compared to ethephon treatments alone. Application of inhibitors of ethylene biosynthesis and/or action, in general, delayed changes that accompanied ripening. They reduced physiological weight loss during storage; with AgNo3 being the most effective. These chemicals also increased fruit firmness at harvest and after storage, with benzothiadiazole causing the maximum increase. The treatments reduced fruit respiration, TTS, sugar and soluble protein contents and the activities of various enzymes. Simultaneously, they increased titratable acidity, starch, pectin and total phenol contents in the fruit. Benzothiadiazole AgNO3 and 2, 4-DNP showed promising results in retaining fruit quality during storage.

634 THAKUR, NARAYAN SINGH. 1988. **Effect of different packagings on the quality of apples during transportation and storage**. Dr. Y.S.Parmar University of Horticulture & Forestry, Solan. 79 p.

Red Delicious apples of medium size were harvested and packed in four types of packagings, viz. telescopic corrugated fibre board carton with trays, telescopic corrugated plastic carton with trays, Universal CFB Kullu pack and conventional wooden box. the apples were transported from the University Orchard, Oachghat, district Solan (at an altitude of 1200 m from M.S.L.) to Delhi by truck covering about 400 km distance, where they were re-packed and kept in cold storage at R.H. Observations were recorded before and after transportation and subsequently during 30 days intervals in storage. Like wooden box, no noticeable damage in plastic and CFB cartons, except pressing of corners of CFB Kullu pack, was observed during transportation. No moisture was observed in plastic carton during transportation and storage. Bruising damage of fruit was minimum in plastic carton, however, trays in cartons helped reducing the bruising damage of fruits. Loss of net weight, gross weight, change in TSS and titratable acidity of fruit was recorded minimum in CFB and

plastic cartons as compared to conventional wooden box during transportation. Loss of net weight, gross weight and firmness, rotting, shrivelling and decrease in titratable acidity of fruits was also recorded minimum in same cartons during storage. No significant difference was observed among different packagings storage. No significant difference was observed among different packagings with respect to other chemical characteristics of fruits during transportation and storage. Sensory evaluation score of fruits increased during transportation and upto 60 days of storage, thereafter it decreased.

635 TRIPATHI, SN; THAKUR, KS. 1994. **Studies on storage of apple in polyethylene bags atmospheric storage**. *Emerging Trends in Temperate Fruits Production*, pp 526-530.

Storage decay

636 AHMAD, NAZIR; KOUL, JL. 1986. **Economics of benzimidazole application in the postharvest disease control of apple fruit stored at aircooled temperatures**. *Research and Development Reporter*, 3: 2, 91-92.

Results of trials showed that benzimidazole fungicides applied as a preharvest spray or fruit dip before storage effectively prevented decay. Fruit dips were cheaper than sprays. Maximum profits were obtained with MBC-50 [carbendazim] followed by Bavistin [carbendazim].

637 BADYAL, KUSUM. 1990. **Studies on storage diseases of crab-apple fruits**. *Indian Journal of Mycology and Plant Pathology*, 20: 1, 79-80.

Fruits of *Docynia indica* were spoiled by *Rhizopus oryzae*, *Geotrichum candidum* and *Alternaria alternata*, none of which have been recorded previously on this host in India. Pathogenicity was confirmed by pin-prick inoculation.

638 CHIB, HS; GUPTA, BR; ANDOTRA, PS; DAR, CN. 1983. **Evaluation of some fungicides for the control of post harvest rots of apple through fungicidal dip in Kashmir**. *Indian Journal of Mycology and Plant Pathology*, 13: 3, 353-354.

Tecto [thiabendazole], Rovral [iprodione] and Bavistin [carbendazim] completely checked blue mould (*Penicillium expansum*) for up to 7 d, while Delan [dithianon], Difolatan [captafol], Rovral and thiabendazole were equally effective against *Rhizopus sp*. Black rot (*Sphaeropsis malorum* [*Botryosphaeria obtusa*]) was completely inhibited by all the test fungicides except Saprol [triforine] up to 7 d. Thiabendazole was the best treatment against all 3 rots and captan the least effective.

639 DHANBIR SINGH. 1989. **Assessment of fungitoxicants for the control of leaf spot and fruit rot of apple and their economics**. *Indian Journal of Mycology and Plant Pathology*, 19: 1, 5-9.

A pre-monsoon spray of benomyl (0.05%) gave the best control of leaf spot (*Sphaeropsis malorum*) [*Botryosphaeria obtusa*] infection, while pre-harvest sprays of thiabendazole (0.05%) and benomyl (0.05%) were the most efficient for reducing fruit rot incidence in storage. Benomyl provided the most favourable cost:benefit ratio.

640 DHANBIR SINGH. 1989. **Differential reaction of fungicides to storage rot of apple**. *Indian Journal of Mycology and Plant Pathology*, 19: 1, 128-130; 8 ref.

Out of 12 fungicides tested, benomyl and thiabendazole were the most effective against *Sphaeropsis malorum* [*Botryosphaeria obtusa*] while nonsystemics were quite useless in controlling fruit rot.

641 DHANBIR SINGH. 1990. **Influence of relative humidity, temperature and host cultivars on postharvest fungal rot of apple**. *Indian Journal of Mycology and Plant Pathology*, 20: 3, 272-274; 8 ref.

When fruits of 10 cultivars were inoculated, infection and severity of rotting by *Sphaeropsis malorum* [*Botryosphaeria obtusa*] were least in Gallia Beauty and Ruspippin. Rotting was most severe at high RH (90-100%) and at temp. between 25 and 35°C.

642 GUPTA, GK; GUPTA, SK. 1990. **Effects of neutral cleaner washing and wax coating on the storage life of scab infected apples**. *Indian Journal of Mycology and Plant Pathology*, 20: 1, 51-53; 6 ref.

Washing and waxing reduced scab (*Venturia inaequalis*) development in infected fruit and increased the storage life of healthy fruits from scabbed trees.

643 GUPTA, GK. 1987. **Investigations on the effect of urea and fungicides in suppressing the ascigerous stage of apple scab pathogen**. *International Journal of Tropical Plant Diseases*, 5: 1, 93-97; 11 ref.

Two post-harvest sprays of carbendazim or dodine in Sep. and Oct. or a single pre-leaf fall spray of urea, carbendazim, thiophanate-methyl, carbendazim + mancozeb, bitertanol, dodine or fenapanil completely suppressed ascospore discharge in *Venturia inaequalis*. The 5% urea spray enhanced the yield of treated trees.

644 GUPTA, GK; VERMA, KD. 1986. **Studies on the keeping quality of apple fruits infected with scab (*Venturia inaequalis*) in late summer season**. *Advances in research on temperate fruits. Proceedings of the national symposium on temperate fruits*. (1984: 15-18 March: Himachal Pradesh Agricultural University, Solan, India). Solan, India: Dr. Y.S. Parmar University of Horticulture and Forestry, p. 307-309; 6 ref.

Apparently healthy Golden Delicious apples from a scab-infected tree developed 5-8 lesions in 36% of the fruits after 90 days of storage at 4°C. Fruits having 10-25 lesions initially, produced more lesions covering almost the entire surface, and 82% of them were rotten after 90 days of storage.

645 GUPTA, OP. 1986. **Extent of incidence of postharvest physiological disorders in apple cv. Red Delicious grown at different locations in Kashmir**. *Research and Development Reporter*, 3: 2, 87-88; 3 ref.

The incidence of bitter pit, sun scald, external corking, shrivelling and water core in apples from the plains (1560 m), low altitude (1560-1650 m) and high altitude areas (> 1650 m) during the 1983/84 and 1984/85 seasons is tabulated. Location appeared to have no effect on incidence but there was a seasonal effect, with a higher incidence of disorders occurring in 1984/85 than in 1983/84.

646 GUPTA, SK; GUPTA, GK; GUPTA, P. 1992. **Efficacy of ergosterol biosynthesis inhibitor fungicides in preharvest sprays against sooty blotch and fly speck diseases of apple**. *Indian Journal of Plant Protection*, 20: 2, 237-238.

647 HABIBUNNISA; ARORA, E; NARASIMHAM, P. 1988. **Extension of the storage life of fungicidal waxol dip treated apples and oranges under evaporative cooling storage conditions**. *Journal of Food Science and Technology, India*, 25: 2, 75-77; 6 ref.

Apples (cv. Royal Delicious) were dipped in a wax emulsion containing 6% total solids and a fungicide (Bavistin [carbendazim] at 1000 p.p.m. a.i.) and stored in ambient conditions (21-28°C, 30-80% RH) for 42 days. Treated fruits showed a 6.3% physiological weight loss and 36.0% shrivelling compared with 9.3% and 59.4%, respectively, for untreated control fruits. Fungal spoilage was 2.7% and 8.3% for treated and untreated apples, respectively. Under evaporative-cooling storage conditions (22-24°C, 90 ± 5% RH) treated and untreated apples showed 2.9% and 3.4% weight loss, respectively. No shrivelling or spoilage of treated or untreated fruits occurred under evaporative-cooling conditions. In a similar study, mandarins, treated with 6% waxol containing Bavistin at 1000 p.p.m. a.i. and stored under evaporative cooling conditions, had a storage life of 20 days compared with 5 days for untreated fruits stored under ambient conditions.

648 JAIN, HK; AGNIHOTRI, NP. 1987. **Presence of thiophanate methyl and MBC residues in apple following post harvest dip**. *Pesticides*, 21: 4, 31-32; 9 ref.

Following dipping in 250 and 500 p.p.m. aqueous suspensions of the fungicides, apples contained 0.76 and 1.2 p.p.m. thiophanate-methyl and 0.52 and 0.9 p.p.m. carbendazim, respectively. After 30d, 73.3-80.3% and 80.8-82.2% of the fungicides had been lost. Since the recommended maximum residue limit is 5 p.p.m. for both, these schedules are safe for commercial application.

649 KAUL, JL. 1982. **Comparative effectiveness of systemic fungicides for control of postharvest fungal rots of apple**. *Indian Phytopathology*, 35: 2, 315-316; 4 ref.

Rots caused by *Penicillium expansum*, *Glomerella cingulata*, *Trichothecium roseum*, *Monilinia laxa* and *Rhizopus stolonifer* were most effectively controlled by thiabendazole at 1000 or 500 p.p.m., followed by 1000 p.p.m. carbendazim.

650 KAUL, JL. 1986. **Efficacy of biphenyl and sodium-orthophenylphenate in controlling fungal rots of apple**. *Indian Phytopathology*, 39: 2, 282-286; 7 ref.

Sodium 2-phenylphenolate (SOPP) at 5000 p.p.m. was significantly superior to SOPP and biphenyl at 2000 p.p.m. in controlling decay in apples dipped 12 h after inoculation with *Trichothecium roseum*, *Monilinia laxa*, *Glomerella cingulata*, *Penicillium expansum* and *Rhizopus stolonifer*.

651 KAUL, JL; SHARMA, RL. 1988. **Efficacy of pre-harvest sprays of systemic fungicides for control of blue mould rot (*Penicillium expansum*) of apple**. *Indian Journal of Mycology and Plant Pathology*, 18: 2, 137-139; 11 ref.

Pre-harvest applications of Bavistin (carbendazim), MBC [carbendazim] and Tecto-60 (thiabendazole) at 250-750 μg/ml prevented post-harvest blue mould in apples stored under both ambient temp. (15-25°C) and air-cooled (6-8°) conditions. Benomyl and Topsin-M (thiophanate-methyl) were less effective. The susceptibility of apples to *P. expansum* increased with the

increase in storage period from 150 to 210 d, irrespective of the fungicide used.

652 KAUL, JL; AHMED, N. 1986. **In vitro bioefficacy of systemic and non-systemic fungicides against *Penicillium expansum Thom* causing blue mould rot of apple**. *Advances in research on temperate fruits. Proceedings of the national symposium of temperate fruits*. (Himachal Pradesh Agricultural University, Solan, India: 1984: 15-18 March). Solan, India: Dr. Y.S. Parmar University of Horticulture and Forestry, p. 415-418; 7 ref.

Of the 7 systemic fungicides tested, Bavistin [carbendazim] and Tecto 60 [thiabendazole] were the most effective against *P. expansum*, causing postharvest decay of apple. The size of the inhibition zone increased with increasing concn, but only up to 200 p.p.m. in the case of carbendazim. Of the 10 non-systemic fungicides, SOPP [sodium 2-phenylphenolate] followed by Difolatan [captafol] were most effective inhibiting growth at 2 p.p.m. Botran [dichloran] and mancozeb proved least effective.

653 KAUL, JL; MUNJAL, RL. 1982. **Fruit wrappers and skin coatings for control of post-harvest decay of apple**. *Indian Journal of Mycology and Plant Pathology*, 12: 2, 179-184; 17 ref.

Apples coated with pungent mustard oil withstood infections caused by *Trichothecium roseum*, *Monilinia laxa*, *Glomerella cingulata*, *Penicillium expansum* and *Rhizopus stolonifer*. Wrappers impregnated with DCNA [dicloran] and sodium ortho-phenylphenate (SOPP) provided some protection.

654 MIR, NA; KOTHA, TK. 1986. **Extent and causes of current fruit losses of apple during transportation and post-harvest handling**. *Research and Development Reporter*, 3: 2, 50-52; 5 ref.

A survey showed that an av. 18.01 and 9.86% of apple fruit had decayed during transit to Jammu and Delhi markets respectively. *Penicillium expansum* was the predominant organism causing 43.9 and 27.5% spoilage respectively. Other pathogens included *Alternaria sp.*, *Glomerella cingulata* and *Monilinia sp.*

655 PATEL, RB. 1984. **Post harvest diseases of apple (*Pyrus malus*) fruits and their control**. *Indian Journal of Microbiology*, 24: 2, 142-143; 8 ref.

Aspergillus niger, *Rhizopus arrhizus* and *Penicillium digitatum* were responsible for most of the decay of apples in Ahmedabad market. Other isolates from rotting fruits included *Pythium ultimum*. Combined chemical treatment and storage in a cold room extended storage life, but wax coating of the fruits was ineffective.

656 SHARMA, ID; AMIT NATH; KAUL, JL. 1991. **Persistance of carbendazim residues in apple following post harvest dip treatment**. *Pesticide Research Journal*, 3: 2, 173-175; 7 ref.

To assess the persistence of carbendazim in apples, fruits were dipped in 500 or 1000 p.p.m. carbendazim for 4 or 8 min, and were then stored at ambient temp. (8.24°C) for 30 d, or in refrigerated storage for 120 d. Residue concn increased with original concn of fungicide and with duration of exposure; apples dipped for 4 min at 500 or 1000 ppm contained 4.87 and 6.58 ppm residues, respectively, while those dipped for 8 min contained 6.24 and 7.68 ppm. Residue concentration decreased faster when fruit was stored at ambient temp. than in refrigeration: 50% of residues were lost within 10 d in ambient temp. while in cold storage, the half life was >60 d. In both cases, >80% of the residues remained on the peel.

657 SHARMA, RL; KAUL, JL. 1990. **Efficacy of hot water and carbendazim treatments in controlling brown rot of apple**. *Indian Journal of Mycology and Plant Pathology*, 20: 1, 47-48; 9 ref.

Hot water treatment combined with 200 p.p.m. carbendazim at 50°C for 4 min was an effective substitute for cold water dips containing 1000 p.p.m. of the fungicide for the control of *Monilinia laxa* and *M. fructigena*.

658 SHARMA, RL; KAUL, JL. 1989. **Incidence of brown rot (*Monilinia spp.*) of apple in Himachal Pradesh**. *Indian Journal of Mycology and Plant Pathology*, 19: 2, 208-211.

In surveys of markets, stores, godowns and canning centres in various parts of the State, the cumulative incidence of brown rot in harvested apples was 5-15.2%. The occurrence of *M. fructigena* varied from 2.1 to 14.2% (av. 6.72%) while *M. laxa* averaged 2.1%. *M. fructigena* was more frequent under low temp. conditions.

659 SHARMA, RL; KAUL, JL. 1990. **Mode of entry and histopathological changes induced by *Monilinia* species in apple fruit**. *Indian Phytopathology*, 43: 1, 113-115; 5 ref.

Histopathological studies showed that infection hyphae of M. spp. (*M. laxa* (isolates I and II), *M. laxa* f.sp. mali and *M. fructigena*) entered fruit within 48 h of inoculation and mycelia colonized the intercellular

spaces after 96 h. After infection was established pathogen hyphae spread through the host tissue and typical rot symptoms appeared. As the disease progressed conidiophores ruptured the fruit epidermis to form small tufts over the surface and the conidia were produced on the sporogenous hyphae. M. spp. caused little degradation of cells and middle lamellae with the result that rotting was firm and dry.

660 SHARMA, RL; KAUL, JL. 1988. **Susceptibility of apples to brown rot in relation to qualitative characters**. *Indian Phytopath.*, 41: 3, 410-415.

Apples of 9 cultivars were susceptible to 4 *Monilinia spp.* (*M. fructigena*, *M. laxa* (isolates I and II) and *M. laxa* f. sp. mali). Golden Delicious, Royal Delicious and Tropical Beauty were highly susceptible but Yellow Newton showed some resistance. *Monilinia laxa*-I had the highest virulence and *Monilinia laxa*-II caused least rotting. The relationships between fruit quality (total sugars, acidity, pH, ascorbic acid, total soluble solids and fruit firmness) and susceptibility to infection were investigated. A significant negative correlation existed between the brown rot pathogens and acidity and fruit firmness. For the remaining factors the correlation was positive, but it was only significant with pH. The regression coeff. of variables on the prevalence of brown rot indicated that pH was the main factor which increased susceptibility significantly whereas other factors did not have significant effects.

661 SHARMA, RL; KAUL, JL. 1988. **Temperature effect on the development of brown rot of apple**. *Indian Phytopathology*, 41: 1, 152-153.

The effect of temp. on the pathogenesis of brown rot (Monilia spp.) on apple were evaluated. Cultures of *M. [Monilinia] fructigena, M. [Monilinia] laxa and M. [Monilinia] laxa f.sp. mali* from infected apples were inoculated to surface sterilized golden delicious apples. Storage at 0°C was most effective for controlling brown rot followed by temp. of 5-10°. Temp. >10° caused rapid decay and maximum rotting occurred at 24-27°. Spread of brown rot was checked at 35° but the high temp. caused adverse effects on fruit. *Monilinia spp.* caused varying degrees of decay at the different temp.

662 SHARMA, YD; CHADHA, TR; GUPTA, GK. 1986. **Breeding of apple varieties with better keeping quality and disease resistance**. *Advances in research on temperate fruits. Proceedings of the national symposium on temperate fruits*. (1984: 15-18 March: Himachal Pradesh Agricultural University). Solan, India: Dr. Y.S. Parmar University of Horticulture and Forestry, , Solan, India, p. 65-68.

Work at Mashobra is briefly outlined. Crosses of Starking Delicious, Red Delicious and Richared with Ambri of Kashmir were made in the early 1960s and the resulting hybrids were evaluated in the 1970s. Further hybrids from crosses made in the USA were incorporated in the breeding programme to improve resistance to scab [*Venturia inaequalis*]. Brief descriptions are given of the varieties produced, namely Ambred (Red Delicious X Ambri), Ambrich (Richared X Ambri), Ambstarking and Ambroyal (both Starking Delicious X Ambri). When parents and hybrids were evaluated for storage quality, Ambred and Red Delicious were best, retaining their quality for 115-117 days under ordinary air-cooled storage.

663 SUMBALI, GEETA; BADYAL, KUSUM. 1990. **Some new market diseases of pome fruits in India**. *Nat. Academy Sc. Letters*, 13: 9, 331-332.

Fruit rot pathogens found during a survey of Jammu markets included *Ceratocystis paradoxa*, *Fusarium acuminatum* [*Gibberella acuminata*], *Aspergillus ustus* and *A. flavus* on apple; *Trichothecium roseum* and *Penicillium expansum* on crab apple; and *P. italicum* on quince.

664 TAK, SK; VERMA, OP; PATHAK, VN. 1985. **Control of *Alternaria* rot of apple fruits by post-harvest application of chemicals**. *Indian Phytopathology*, 38: 3, 471-474; 11 ref.

Of a number of fungicides, growth regulators, fats and oils tested for the control of *A. alternata*, the most effective were Rovral (iprodione), maleic hydrazide and hydrogenated groundnut oil as both pre- and post-inoculation treatments.

665 VERMA, AN; GOVIND, S; GHOSH, SP. 1982. **Post harvest storage of apple under natural conditions of Shillong**. *Journal of Research Assam Agricultural University*, 3: 1, 92-94; 4 ref.

Following treatment with Bavistin at 0.2% +6% wax emulsion fruits could be stored successfully for up to 60 days in the hills at Meghalaya.

666 VERMA, BL. 1989. **An unrecorded post-harvest disease of apple in Kumaun hills**. *Current Science*, 58: 16, 919-920; 10 ref.

During 1986-87 a survey of pre- and postharvest diseases of apples grown in Bhowali, Chaubattia, Champawat and Mukteshwar in the Kumaun region, India, was carried out. Golden Delicious apples were

found to be infected by *Cordana musae* during storage. The causal organism was isolated and its pathogenicity was confirmed. The pathogen was isolated for the first time from diseased apple fruits in the Kumaun hills. Various injuries facilitate the entry of the pathogen during harvesting, packing and transportation.

667 VERMA, KD; GUPTA, VK; VERMA, HS. 1986. **Role of fungicides in the control of fruit spots and storage rots of apple**. *Advances in research on temperate fruits. Proceedings of the national symposium on temperate fruits*. (1984: 15-18 March: Himachal Pradesh Agricultural University, Solan, India). Solan, India: Dr. Y.S. Parmar University of Horticulture and Forestry, p. 411-414; 7 ref.

Sooty blotch (*Gloeodes pomigena*) and flyspeck (*Microthyriella rubri*) fruit spots were most effectively controlled by 3 pre-harvest sprays of difolatan (0.2%); Bavistin [carbendazim] (0.05%) was next most effective, followed by thiophanate methyl (0.1%). However, thiophanate methyl was better than the other treatments in controlling storage rots [unspecified]. Post-harvest dipping with Bavistin maintained fruit quality and prolonged shelf life.

PEARS

Postharvest handling

668 DI CESARE, LF; TESTONI, A; SANSOVINI, G. 1993. **Study on the volatile compounds of prickly pear during storage under normal and controlled atmosphere**. *Industrie Alimentari (Italy)*, 32: 317, 725-730, 733.

669 MANN, SS; BALJIT SINGH; SINGH, B. 1990. **Effect of Ethrel on ripening of fruits of Patharnakh pear harvested on different dates**. *Acta Horticulturae*, No. 279, 529-532; 4 ref.

Pyrus pyrifolia fruits harvested 140 or 150 days after initial set were treated with 250, 500 or 1000 ppm. Ethrel for 1 min. Fruit firmness and TSS, acids, starch, sugar, total phenolics and pigment contents were determined at 5, 10 and 15 days after treatment. At higher conc. of Ethrel, fruit firmness decreased more rapidly than in the controls. TSS tended to increase during ripening, the increase being greater with high Ethrel concentrations, while acidity decreased. Starch content decreased sharply during the initial 5-10 days with both harvesting dates. Pigments increased while phenolics decreased during ripening.

670 MANN, SS; KUSHAL SINGH. 1986. **Effect of post-harvest application of Ethrel on ripening and quality of Patharnakh pear**. *Advances in research on temperate fruits. Proceedings of the national symposium on temperate fruits*. (1984: 15-18 March: Himachal Pradesh Agricultural University, Solan, India). Solan, India: Dr. Y.S. Parmar University of Horticulture and Forestry, p. 311-314; 9 ref.

Harvested fruits were dipped in 0-1000 p.p.m. ethephon for 30 s and stored in polyethylene bags at 0-3.3°C for 7-15 days. Palatability was enhanced by ethephon, especially at 250 p.p.m., and the colour was improved (golden-yellow instead of green). Fruit firmness was reduced by ethephon in proportion to the concentration. TSS content was increased by ethephon but effects on acidity were variable.

671 RAI, RM; TEWARI, JD. 1987. **Effect on pre-harvest sprays of growth regulators on post-harvest physiological changes in pear**. *Progressive Horticulture*, 19: 1-2, 99-104; 7 ref.

Trees of the cv. Victoria were sprayed with Cycocel [chlormequat], Alar [daminozide], 2,4,5-T, or Alar + 2,4,5-T some 35 days after petal fall. After harvest the fruits were stored at room temperature and 60-80% RH. Treatment with Cycocel at 1000 and 2000 p.p.m. or Alar at 1000 and 2000 p.p.m. improved the storage life by inhibiting protopectin hydrolysis, ethylene production and respiration.

672 RANDHAWA, JS; DHILLON, BS; BAL, JS. 1984. **Effect of different treatments and date of harvesting on pectin methyl esterase activity during ripening of Patharnakh pear fruits, *Pyrus pyrifolia (Burm.) Nakai***. *Science and Culture*, 50: 12, 358-360; 7 ref.

Fruits of this cv., which produces very hard pears, were harvested at weekly intervals between 22 July and 12 August in one year and between 15 July and 15 August in another year. Some fruits were dipped for 2 minutes in Ethrel [ethephon] at 500 or 1000 p.p.m., some were wrapped in newspaper enclosing CaC2 at 1 or 2 g/5 kg fruit and some were held at 21-24°C. The fruits were sampled for enzyme activity, and fruit firmness was assessed after 12 days. The data are tabulated. The highest enzyme activity and lowest fruit firmness were observed in fruits harvested on the last dates and ripened with 2 g CaC2.

673 SANDHU, SS; RANDHAWA, JS. 1988. **A note on the effect of fungicides on the storage behaviour**