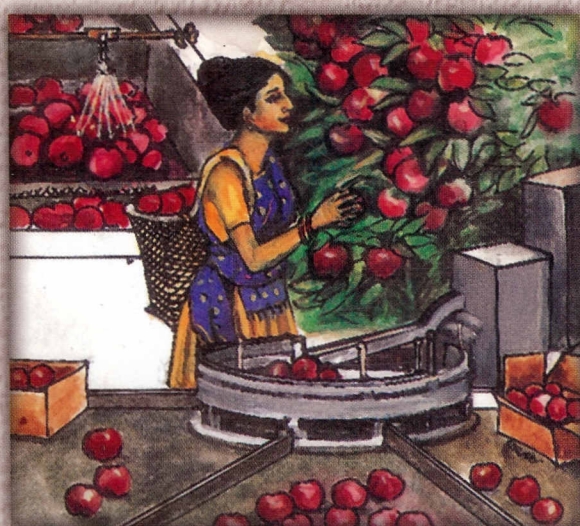




SAARC

Postharvest Management in Agriculture

SAARC Bibliographical Database



SAARC Agricultural Information Centre

Postharvest Management in Agriculture

SAARC Bibliographical Database

A S Chandel and R M Kamal



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

CONTENTS

<i>Preface</i>	i
<i>Introduction</i>	ii
POSTHARVEST EQUIPMENTS	1
PACKING MATERIALS	14
AGRICULTURAL PRODUCE	25
CEREAL GRAINS	27
WHEAT	31
SORGHUM	35
MAIZE	36
BARLEY	38
MILLETS	38
RICE	39
SOYBEANS	60
VIGNA	62
LENTILS	66
STARCH CROPS	66
CASSAVAS	68
TOBACCO	70
COFFEE AND TEA	71
GARLICS	72
GINGERS	73
TURMERICS	75
SPICES	76
OILS	77
FRUITS	78
APPLES	83
PEARS	89
APRICOTS	90
PEACHES	91
PLUMS	92
PRUNUS DOMESTICA	94
CHERRIES	94
LITCHI CHINENSIS	94
CITRUS	95
ORANGES	97
KINNOWS	98
LEMONS	101

GUAVAS	102
SAPOTA	105
MANGOES	107
NUTS	115
COCONUTS	116
DATES	117
POMEGRANATES	118
PAPAYAS	118
JACKFRUITS	119
AEGLE MARMELLOS	120
AMLA	121
BERRIES	121
BANANAS	122
PINEAPPLES	126
ZIZIPHUS MAURITIANA	126
GRAPES	128
VEGETABLES	133
CARROTS	136
POTATOES	138
ONIONS	144
CAULIFLOWERS	151
TOMATOES	151
BRINJALS	156
PEAS	157
GROUNDNUTS	159
MUSHROOMS	162
OTHER VEGETABLES	163
FLORICULTURE	164
DAIRY SCIENCE	166
FOOD TECHNOLOGY	191
JUICES	205
WINE AND BEVERAGES	211
SEED TECHNOLOGY	213

Term Index

i

Author Index

xvi

Scott; S Wiersema; PI Ferguson. CIP, Lima (Peru) p.331-353.

1080 ROBERTSON, DG. 1990. Report of a mission to India to formulate a project on village-level processing of potato. 27 p.

1081 ROY, SK. 1991. The role of village level processing in meeting the demand for potato products. Third Triennial Conference. (Bombay: 1991: 17-22 June). Asian Potato Association.

1082 SHIRSAT, SG; THOMAS, P; NAIR, PM. 1994. Effect of gamma-irradiation and CIPC treatment on processing quality of potatoes. *Journal of Food Sc. and Tech.* - Mysore, 31: 2, 130-134.

The processing quality of 5 potato cultivars, after inhibition of sprouting by irradiation or chloroisopropyl phenyl carbamate treatment, was compared during storage at 20, 15 and 10°C up to 9 months. Cultivars 'K. Jyoti', 'K Lavkar', 'Gujrat-S' and 'Talegaon'. with initial reducing sugar levels of 120 to 240 mg/100 g. yielded light coloured chips and French fries. Neither of the treatments affected the processing quality of these cultivars. when stored at 15 and 20°C up to 6 months, but the storage at 10°C resulted in darker products, due to higher levels of reducing sugars. In tubers, stored for more than 6 months at 15°C, reconditioning at 27-32°C or blanching improved the colour of the products. Cultivar 'K. Badshah', with initial reducing sugar levels of 3 10 to 440 mg/100 g, was not suitable for processing. In vitro infiltration studies showed that glucose contributed to browning more than fructose or sucrose.

1083 SUSHEELAMMA, NS; CHANGALA REDDY, G; RUKMANI, CS; THARANATHAN, RN. 1992. Studies on sweet potatoes. Part I: Changes in the carbohydrates during processing. *Starch Staerke* (Germany, F.R.), 44: 5, 163-166.

1084 TRESP, N. 1988. Integrated potato processing technologies in India. *Appropriate Technology International Bulletin*, No. 16, 4 p.

The integrated processing technologies introduced are storage of surplus potatoes, processing and drying of stored potatoes into chips, and the milling of chips into powder. The rustic stores proposed are mud huts with thatched roofs, designed to be cool, dark, and properly ventilated; their capacity varies from 5 to 15 tons and storage time can be for up to 3 months. These stores can also be used for ginger, onions, paddy rice and dry fodder. The floor is a slatted platform constructed with

bricks and bamboo; a layer of sand underneath is flooded with water, the operation of the store being one of passive evaporative cooling. The processing of the dried potato slices and potato powder is also described with details of markets and price.

1085 TRIPATHI, VK; JAIN, SP; RAM, HB; SURJEET SINGH. 1983. Studies on enzymatic and non-enzymatic discolouration in tubers of some potato varieties. *Progressive Horticulture*, 15: 1/2, 152-154; 18 ref.

Three varieties studied did not differ in phosphate content, but there were varietal differences in contents of tyrosine and total proteins. C2703 and Kufri Chandramukhi, which contained comparatively high levels of tyrosine and total proteins, showed less enzymatic and nonenzymatic discoloration than did Kufri Sinduri. It is concluded that C2703 and Kufri Chandramukhi are superior in processing quality to Kufri Sinduri.

ONIONS

Drying

1086 MAINI, SB; DIWAN, B; GUPTA, SK; ANAND, JC. 1981. Studies on solar dehydration of onions. *Progressive Hort.*, 13: 3-4, 29-32.

1087 NETRA PAL; NARENDRA SINGH. 1988. Analysis of genetic architecture for total soluble solids, total insoluble solids and drying ratio in onion (*Allium cepa* L.). *South Indian Horticulture*, 36: 1-2, 77-80; 3 ref.

Parents and F1s from a diallel cross (excluding reciprocals) involving 8 diverse inbred lines were analysed using the Jinks and Hayman method to give estimates of components of variation for the quality parameters studied. It is suggested from the results that total insoluble solids could be improved by heterosis breeding, while both heterosis breeding and conventional breeding methods could be used to improve total soluble solids, total solids and drying ratio.

1088 VIJAY, S; ANAND, JC. 1973. Netrapal and Bhagchandani, screening of white onion cultivars for use in dehydration. *Indian Food Packer*, 27: 5, 5.

Storage

1089 BHALEKAR, MN; KALE, PB; KULWAL, LV. 1987. Storage behaviour of some onion varieties (*Allium cepa* L.) as influenced by nitrogen levels and

preharvest spray of maleic hydrazide. *PKV Research Journal*, 11: 1, 38-46; 8 ref.

In trials with 7 cultivars the plants received N at 0, 75 or 150 kg/ha and they were sprayed with MH at 0, 2000 or 4000 p.p.m. 3 weeks before harvest. The harvested bulbs were cured in the shade for 10 days and then stored for 160 days in a single layer on a hard ground floor in a well ventilated room. Irrespective of treatment, Pusa White Flat, Pusa Ratnar, Pusa Red and Local White showed the best storability. These cultivars also gave the highest yields. The highest N level had an adverse effect on storability. Storage losses through sprouting and [unspecified] rotting were reduced best by MH at 4000 p.p.m.

1090 BHATNAGAR, AK; TYADI, RPS; BONSODE, PC. 1989. **Handling, storage and marketing of onions.** *PKV Research Journal*, 13: 2, 135-139; 6 ref.

A survey in Nashik and Pune of numerous small-, medium- and large-scale growers showed that most did not store the bulbs but sold them immediately after harvest. The reasons for quick sale were: need for cash, uncertainty over price increases during storage, storage losses, and high storage costs. The need for low-cost storage is emphasized.

1091 CHADHA, ML; SIDHU, AS. 1989. **Studies on post-harvest storage life of kharif onion under ambient conditions: a note.** *Haryana Journal of Horticultural Sciences*, 18: 1-2, 150-151.

In 2-year trials with the cultivar N-53 the crop was planted on 23 July in one year and on 16 Aug. in the other and the bulbs were harvested on 20 Nov. and 13 Dec., respectively. The bulbs, with the tops intact or removed immediately after harvest or 5, 10 or 15 days later, were stored for 2.5 months at temperatures ranging from 11 to 20°C and 65-72% RH. The average percentage of sprouted bulbs at the end of storage was highest in bulbs with the tops intact (35.78%) and lowest (7.42%) in those with the tops removed 15 days after harvest.

1092 CURRAH, L; PROCTOR, FJ. 1990. **Onion harvesting, drying and storage.** *Bulletin - Natural Resources Institute*, Natural Resources Institute, Central Avenue, Chatham Marine, Kent ME4 4TB, UK. No. 35, 65-90.

Factors influencing the storage of onions in the tropics are discussed. Preharvest cultural factors, treatment with sprout suppressant, time of harvesting, harvesting and handling damage, onion stores and management strategies are considered. Cold storage experiments in the

tropics and storage at high temp. in the UK, Brazil, India, Bangladesh and Costa Rica are reported. A mathematical modelling approach to onion storage is also discussed.

1093 DEORE, BP; PATIL, SK; KATE, RN. 1985. **Studies on onion storage.** *Journal of Maharashtra Agricultural Universities*, 10: 2, 224.

Data are tabulated on percentage storage losses, averaged over 3 years, for 18 cultivars and lines after 1-4 months in storage at room temperature with good ventilation. There was wide variation among genotypes, particularly after the first month; Sel. 910 showed the smallest losses after 4 months (56.02%).

1094 KALE, SM; KULWAL, LV; KALE, PB. 1987. **Effect of nitrogen levels and preharvest foliage application of maleic hydrazide (MH) on yield and storage of onion.** *PKV Res. Journal*, 11:1, 87-90; 7ref.

In trials with the cv. Local White the plants received N at 0, 60, 120 or 180 kg/ha and they were sprayed with MH at 0, 2000 or 4000 p.p.m. 15 days before lifting. The bulbs were stored for 160 days under room conditions. The yield rose with N levels from 344.86 q/ha at zero N to 516.18 q/ha at 180 kg N/ha. The least rotting, sprouting and physiological weight loss occurred with bulbs grown with 120 kg N/ha and sprayed with MH at 2000 p.p.m.

1095 KAMAT, SR; OJHA, KL; YADAV, BP. 1987. **Micro-organisms associated with onion bulb and their control.** *Indian Journal of Plant Pathology*, 5: 2, 193-194; 5 ref.

Samples of 100 bulbs from each of 7 districts in Bihar yielded isolates of 10 fungi and 1 bacterium, *Erwinia carotovora* [subsp. *carotovora*]. Of 7 chemical treatments evaluated for controlling storage rot, the best control was given by Bavistin [carbendazim] + Plantomycin, each at 0.05% resulting in 3.3% rot compared with 100% in untreated bulbs.

1096 KAUR, S; RANDHAWA, KS; ARORA, SK; MOHAN SINGH. 1987. **A note on the studies on the purple blotch of onion as affected by pre-harvest sprays of growth inhibitors.** *Haryana Journal of Horticultural Sciences*, 16: 1&2, 140-141; 6 ref.

In trials with the cv. Punjab Selection, storage losses due to *Alternaria porri* were reduced most and seed yield was increased most by spraying with MH at 2000 mg/litre. Data on other treatments with NAA or succinic acid are tabulated.

1097 KHAN, I. 1992. Radiation preservation of onions under tropical conditions. *Research Co-ordination Meeting on the Asian Regional Co-operative Project on Food Irradiation: Technology Transfer: Proceedings.* (Bangkok (Thailand): 1988: 31 Oct - 4 Nov. Vienna (Austria): Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, p. 11-19.

1098 MAINI, SB; DIWAN, B; ANAND, JC. 1984. Storage behaviour and drying characteristics of commercial cultivars of onions. *J. Fd. Sci. & Tech.*, 21: 417-419.

1099 MAINI, SB; DIWAN, B; KUMAR, R; LAL, BB; ANAND, JC. 1989. Studies on packing and storage of onions. *Seeds and Farms*, 15: 3, 29-30.

Bulbs were packed in (1) gunny bags or (2) gunny bags lined with perforated polyethylene, and stored in ambient conditions (28-33°C) for 3 months. The effects were also studied of stacking 50-kg gunny bags (3) in 5 layers or (4) 7 layers on the percentage of bulb crushing, and (5) of burning the basal portion of each bulb on sprouting percentage. Although there was 40% desiccation in (1), decay losses in (2) were 78%. There were 7% crushed bulbs in (3) and 28% in (4). Only 10% sprouting occurred in (5).

1100 MURTHY, KCK; VISHWANATH, AP; BABU, CK; SUBRAMANYA, S. 1987. Harvest and post harvest technology of onion. *Research Bulletin, University of Agricultural Sciences, Bangalore, UAS/H-PHT/87/15*, 43 pp.; 35 ref.

Research carried out on harvest and post-harvest handling of onions since 1979 is reported covering many aspects including nutritive value, varieties, production practices, harvesting, curing and drying, storage, storage structures, and chemical inhibitors.

1101 MURTHY, KCK; VISHWANATH, AP; BABU, CK; RAMAKUMAR, MV. 1988. Onion storage in 'Nasik' type structure. *Current Research, University of Agricultural Sciences, Bangalore*, 17: 11, 149-151; 3 ref.

Bulbs of the cv. Bellary Red, harvested in early summer at lifting maturity, were dried and air-cured under shade. The Nasik-type storage structure is illustrated and data are tabulated on the cost of construction of a 10 ton capacity store. Each compartment of the store holds 475-500 kg and the bulbs were held there for 5 months. The total storage losses at the end of this period were 21%, which was considered acceptable. The total cost of the structure was Rs 5000.

1102 NAGRE, PK; KULWAL, LV. 1987. Effect of different dates of transplanting, spacing and preharvest spray of maleic hydrazide (MH) on storage behaviour of onion. *PKV Research Journal*, 11: 2, 151-155; 6 ref.

In trials with the cv. Local White transplanting of seedlings was carried out on 15 Dec., 15 Jan. or 15 Feb. and the plants were spaced at 15X10, 15X15 or 15X25 cm. MH at 2000 p.p.m. was applied before harvest and the bulbs were stored in room conditions for 160 days. Storage losses through rotting were greatest with Dec. transplanting, and sprouting was highest with Feb. transplanting. Treatment with MH was only slightly effective in controlling storage sprouting. The best results generally were obtained with Jan. transplanting at 15X10 cm.

1103 NAWAZ, A; WAHID, M; INAYATULLAH, H. 1988. Effect of maleic hydrazide spray and irradiation on the storage of onions. *Nucleus Karachi*, 25: 1-2, 39-42; 22 ref.

A red-skinned onion cultivar was sprayed with MH at 1000, 1500 and 2000 p.p.m. 2 weeks before harvest. The produce was gamma irradiated (0.08 and 0.12 kGy) and stored for 4 months at ambient temperatures (25-45°C, RH 50-75%). Sprouting was completely inhibited by radiation doses of 0.08 and 0.12 kGy. MH was partially effective in delaying sprouting, but even 2000 p.p.m. could not stop sprouting. Rotting increased during storage in all the treatments; it was highest in untreated onions, intermediate in irradiated onions, and lowest in onions treated with 2000 p.p.m. MH. Significant moisture loss occurred in all the stored onions. This loss was highest in control and lowest in MH-sprayed samples. Overall acceptability/sensory quality scores indicated that irradiated samples were rated highest.

1104 PANDEY, DK. 1994. Improved longevity of onion (*Allium cepa* L.) seeds by immersing in hexylene glycol. *Scient. Hort.*, 59: 3-4, 297-302.

Onion (*Allium cepa* L. cv. 'Arka Niketan') seeds with different moisture contents were sealed hermetically or immersed in liquid desiccants, i.e. ethylene glycol, propylene glycol, glycerol, diethylene glycol, hexylene glycol and triethanolamine and stored at ambient temperature. Viability and vigour in the seeds were monitored during storage. The seeds stored hermetically at 10% moisture content (MC, fresh weight basis) lost viability completely in about 300 days. The seeds immersed in the liquid desiccants except those in hexylene glycol, imbibed the chemicals and lost viability

completely in a period of about 1-4 years. There was no loss of viability in the seeds immersed in hexylene glycol for 1100 days. However, some loss of viability and substantial loss of vigour in terms of reduction in growth of seedlings was detected subsequent to storage for 1460 days. The seeds hermetically stored at 8% MC lost viability in about 1100 days. The seeds with 2% MC stored hermetically or immersed in hexylene glycol did not show apparent loss of viability even after 1460 days storage, though a slight loss of seed vigour as evidenced by decline in growth of seedlings was shown by the seeds immersed in the hexylene glycol. The longevity of undried seeds immersed in hexylene glycol was intermediate between that of seeds with 8% and 2% MC both hermetically stored. The results suggest preservation of onion seeds in hexylene glycol as a simple and cost effective method for improving short- or medium-term longevity at ambient temperature.

1105 PATIL, JD; DESALE, GY; KALE, PN. 1987. **Correlation studies on morphological and storage characters of some onion varieties.** *Journal of Maharashtra Agricultural Universities*, 12: 1, 114-115; 3 ref.

Analysis of data on 7 yield and growth traits and 4 traits related to loss whilst in storage from 45 cultivars grown in the field during the 1982-83 *rabi* season and stored in bamboo baskets under ambient conditions revealed that (1) the thin-neck trait is fairly reliable for selecting varieties with potential for extended storage life, (2) selection for large bulbs is likely to result in poor storage quality, and (3) percentage of bolting and percentage of twin bulbs were both directly related to storage loss.

1106 PATIL, JD; DESALE, GY; KALE, PN. 1988. **Storage studies in onion.** *Journal of Maharashtra Agricultural Universities*, 13: 1, 91-93.

Bulbs of 45 cultivars [none named] harvested when 50% of the tops were bent over were field-cured for a week and stored at room temperature for 6 months. Total and physiological weight loss, sprouting and decay were determined at monthly intervals. The data [averaged for the cultivars] are presented graphically. At the end of storage, losses due to decay, sprouting and weight loss amounted to 43.02, 10.62 and 37.45%, respectively.

1107 PATIL, RS; KALE, PN. 1985. **Correlation studies on chemical composition and keeping quality of some onion cultivars.** *Journal of Maharashtra Agricultural Universities*, 10: 2, 154-155; 9 ref.

Data are tabulated on phenotypic and genotypic correlation coefficients among 4 storage-quality characters and

7 chemical composition characters measured in bulbs of 37 cultivars. Total storage losses were positively correlated with protein content and negatively correlated with content of ash, K, dry matter, total soluble solids and nonreducing sugars. Seroli 1, Adsuli 1 and Pusa Red showed the least storage losses.

1108 PATIL, RS; KALE, PN. 1985. **Genetic divergence in onion (*Allium cepa* L.) with respect to storage quality.** *Maharashtra Journal of Horticulture*, 2: 1, 53-59; 6 ref.

By application of the Mahalanobis D² statistic to data for 20 bulb characters, 37 cultivars from different parts of India were grouped into 18 clusters with substantial genetic divergence between them. The largest cluster had 5 varieties, and there were 10 single-variety clusters. The clustering pattern was not directly associated with the geographical distribution of the cultivars.

1109 PATIL, RS; KALE, PN. 1989. **Screening of onion cultivars for storage quality.** *Vegetable Science*, 16: 1, 56-61; 10 ref.

Losses due to sprouting, rotting and physiological loss in weight during 6 months storage were assessed in 12 cultivars. Lower storage losses than those of the control were recorded for all 12. Seroli 1 showed the lowest storage loss (29.25%) while VL1 had the highest (94.00%). During the first month of storage most of the losses were due to physiological weight loss and rotting while in the last month they were due to sprouting.

1110 RANDHAWA, KS; MOHAN SINGH; KOONER, KS. 1987. **Studies on the storage of onion (*Allium cepa* L.) as affected by different chemicals.** *Punjab Vegetable Grower*, 22, 15-17; 11 ref.

Bulbs of a red variety were harvested on 20 May, cured for 15 days and treated with MH at 1000-3000 p.p.m., NAA at 500-1500 p.p.m. or succinic acid at 500-1500 p.p.m. Treatment with MH at 2000 p.p.m. gave the best control of sprouting, decay and weight loss in storage over 5 months.

1111 RAY, SKD; KABIR, J; CHATTERJEE, R; MITRA, SK. 1991. **Effect of preharvest foliar spray of some chemicals on storage behaviour of onion.** *Onion Newsletter for the Tropics*, No. 3, 23-25; 6 ref.

Onion plants (cv. Sanchi) were sprayed 20 days before harvesting (mid-Apr.) with 40% Ethrel [ethephon] (1.25 or 2.5 ml/litre), NAA (1000 or 2000 mg/litre), 2,4,5-T (500 or 1000 mg/litre) or MH [maleic hydrazide] (2000 or 3000 mg/litre). The bulbs were cured for 20 days after harvesting, and then stored for 4 or 8 months in

crates at ambient temperature (20.6-30.7°C) and RH (76.0-81.3%). Preharvest spraying with MH (3000 mg/litre) or Ethrel (2.5 ml/litre) resulted in the lowest percentage of rotting bulbs [pathogen unspecified] after 4 months (0.9 and 3.0%, respectively) and 8 months (2.1 and 5.5%, respectively) of storage, compared with the control treatment (17.0 and 21.3% rotting after 4 and 8 months of storage, respectively). MH (particularly at 2000 mg/litre) reduced sprouting during storage, whereas both 2,4,5-T treatments increased sprouting during storage.

1112 SHANTHI, K; BALAKRISHNAN, R. 1989. Effect of nitrogen, spacing and maleic hydrazide on yield, nutrient uptake, quality and storage of MDU.1 onion. *Indian Journal of Horticulture*, 46: 4, 490-495; 21 ref.

In trials with the cultivar MDU.1, plants spaced at 45 X 5, 45 X 10 and 45 X 15 cm received N at 30, 60 or 90 kg/ha + P₂O₅:K₂O at 60:30 kg/ha as a basal dressing. Half of the N was applied at sowing and the other half 30 days later. MH at 1000 or 2000 p.p.m. was applied 30 and 60 days after sowing. The highest yield, best bulb quality, highest nutrient uptake, and lowest storage losses (sprouting, rotting, rooting and weight loss) were obtained by spacing at 45 X 5 cm and by applying N at 90 kg/ha and MH at 2000 p.p.m.

1113 SINGH, J; DHANKHAR, BS. 1992. Biological changes of onion bulbs during storage as influenced by preharvest treatment. *Vegetable Science*, 19: 1, 86-91.

1114 SINGH, J; DHANKHAR, BS. 1991. Effect of mineral nutrition on physico-chemical changes of onion bulbs during storage. *Scientific Horticulture*, 2: 75-81.

1115 SINGH, J; PANDEY, UC; SRIVASTAVA, VK. 1992. Evaluation of onion cultivars for storage quality. *Haryana Journal Horticulture Science*, 21: 1-2, 83-85.

1116 THAMIZHARASI, V; NARASIMHAM, P. 1993. Effect of heat treatment on the quality of onions during long-term tropical storage. *International Journal of Food Science and Technology*, 28: 4, 397-406.

Onion bulbs (cv. Nasik red) were exposed to hot air currents prior to storage to curtail storage losses. Treatments at 80°C for 30 min or 60°C for 1 h resulted in heat damage while temperatures of 60°C for 30 min

of 50°C for 3 h or 40°C for 48 h did not cause any heat damage to the bulbs. A commercial lot treated at 47, 50 or 53°C for 3 h and another commercial lot treated at 47 or 50°C for 2-5 h, were stored for 4 or 5 months in ventilated polyethylene bags at (1) ambient conditions 20-30°C, RH 50-80%, and (2) 21 ± 1°C, RH 60-65%. In general the treated lots had more marketable bulbs, with less incidence of *Aspergillus niger* infection than untreated controls. Factorial experiments using temperatures 47, 50, and 53°C with durations of treatment between 2 and 5h revealed that the temperature and duration of heat treatment had a significant effect on the yield of good bulbs and reduction in microbial spoilage during storage. Treatment at a temperature from 47 and 50°C for a duration between 2 and 4 h gave best results when stored at 21 ± 1°C. The effect of treatment lasted up to 3 months in storage.

1117 THAMIZHARASI, V; NARASIMHAM, P. 1991. Water vapour sorption and transmission by onion (*Allium cepa* L.) scale under different temperature and humidity conditions. *Scientia Horticulturae*, 46: 3-4, 185-196; 9 ref.

The sorption behaviour of isolated outer dry scales of onion cv. Nasik Red bulbs showed that they had a higher equilibrium moisture content (EMC) at 25° than at 40°C when the RH was <80%, but when RH was >80% the EMC was higher at 40°. Large differences between adsorption and desorption EMC were noted during holding at room temperature (25°-32°) at RH between 35 and 80%. At 80% RH, the EMC was approximately 12% with the differences between adsorption and desorption EMC being lower than at other RH. The EMC of intact scales was higher at ≤ 50% RH, at both 25 and 40°, than the EMC of isolated dry scales, but tended to decrease with an increase in RH from 50 to 80%. Under all RH combinations tested, the water vapour transmitted through the scales was lower at a constant temperature of 25° than either at a constant temperature of 35° or at room temperature, as the vapour pressure deficit at 25° was lower. Storage of onion bulbs in ventilated low-density polyethylene bags, at 21 ± 1° and 60-65% RH showed a highly significant reduction in microbial spoilage (*Aspergillus niger*) along with marginal differences in physiological loss in weight and sprouting compared with those stored at ambient conditions (22-32° and 50-80% RH).

1118 VIJAYAKUMAR, RM; SUNDARARAJAN, S; KUMAR, N. 1987. Effect of growth regulators on the postharvest physiology of small onion (*Allium cepa* L. var. *aggregatum* Don). *South Indian Horticulture*, 35: 4, 299-303; 8 ref.

In trials with the cv. Co.4, Ethrel [ethephon] at 250 or 500 p.p.m. or MH at 2000 or 3000 p.p.m. was applied 15 days before harvest. The bulbs were cured for 3 days before storage at ambient temperature. All treatments reduced storage losses, with MH at 2000 p.p.m. being the most effective.

1119 VISHWANATH, AP; BABU, CK; NARASE-GOWDA, NC; KRISHNAMURTHY, KC. 1989. Production and post harvest handling of onion in Karnataka. Mysore Journal of Agricultural Sciences, 23: 3, 399-405; 3 ref.

A survey was carried out in the onion-growing areas of Karnataka on production practices, storage method and marketing patterns. A questionnaire was sent to 30 farmers having marginal (<1 ha), small, medium or large (>4 ha) holdings selected at random from 3 villages in 3 districts (Chickballapur, Raichur and Dhawar) in Karnataka. The general characteristics of onion cultivation, postharvest operations and marketing of onion in the 3 districts are discussed. The results of the survey are tabulated by region and by holding size. The greatest percentage of the area under onion cultivation was on large holdings (39.09-69.74%), followed by small (18.42-29.67), medium (7.24-23.53%) and marginal (4.60-15.75%) holdings. Average yields were highest in Chickballapur (12.2 t/ha), followed by Raichur (9.7 t/ha) and Dharwar (0.82 t/ha). The higher yields in Chickballapur are due to intensive cultivation practices and the availability of irrigation facilities throughout the growing period. Farmers in Dharwar and Raichur districts sold their onions immediately after harvest while many farmers in Chickballapur stored the onions for up to 3 months. Cost benefit analysis showed a net gain of 5.05% after 15 days' storage and 11.42% after 90 days' storage compared with immediate sale.

Storage decay

1120 BANERJEE, MK; MANGAL, JL. 1986. Chemicals in prolonging keeping quality of vegetables - a review. Haryana Journal of Horticultural Sciences, 15: 3/4, 249-254; 110 ref.

A review and discussion on the effects of growth regulators and fungicides on tuber crops (potatoes); bulb crops, including onions and garlic; cole crops, including cabbages, Brussels sprouts and broccoli; leaf vegetables, including celery and lettuce; Solanaceous fruit vegetables, including tomatoes and aubergines; cucurbits, including cucumbers, melons, watermelons, Momordica charantia and Trichosanthes anguina [T. cucumerina]; root crops, including carrots and radishes; and others,

including okras and strawberries.

1121 DANG, JK; GUPTA, PC. 1984. Chemical control of storage rot of onion bulbs caused by Fusarium solani. Haryana Agricultural University Journal of Research, 14: 3, 403-404; 11 ref.

Pre-inoculation treatments with 2,4-D, potassium metabisulphite, diphenylamine and acetic acid gave 58% reduction in rotting but none of the post-inoculation treatments was effective in controlling the disease.

1122 DANG, JK; SINGH, JP. 1982. Effect of temperature and humidity on storage rot of onion bulbs caused by Fusarium solani. Haryana Journal of Horticultural Sciences, 11: 1/2, 77-80.

The amount of bulbs that had rotted after 15 days of storage at 10, 15, 20, 25, 30, 35 or 40°C was 0, 0, 33, 66, 25, 16 and 0%, respectively, and at 0, 20, 40, 60, 80, 90 or 100% RH the figures were 0, 0, 8, 16, 41, 59 and 41%, resp.. The figures on disease intensity are also tabulated.

1123 GUPTA, RP; MEHRA, USHA; PANDEY, UB. 1986. Bacterial brown rot of onion in storage -a new record from India. Indian Journal of Plant Pathology, 4: 2, 184.

Occurrence of brown rot, caused by *Pseudomonas aeruginosa*, is newly reported and was responsible for losses particularly in Uttar Pradesh.

1124 GUPTA, RP; SRIVASTAVA, KJ; PANDEY, UB. 1991. Management of onion diseases and insect pests in India. Onion Newsletter for the Tropics, No. 3, 15-17; 7 ref.

The major field diseases include damping-off, caused by *Fusarium oxysporum* f.sp. *cepae* and *Pythium butleri*; blight (*Stemphylium vesicarium*); purple blotch (*Alternaria porri*); and basal rot (*F. oxysporum* f.sp. *cepae*); while of lesser importance are downy mildew (*Peronospora destructor*), various leaf blights, smut (*Urocystis cepulae*) and onion yellow dwarf potyvirus. Storage rots are caused by *Pseudomonas aeruginosa*, *Aspergillus niger* and *F. oxysporum* f.sp. *cepae*. Recommended control measures for the field diseases are described and measures outlined for reducing losses in storage. *Thrips tabaci* is the only pest of economic importance. Field pests causing minor losses include *Hylemyia antiqua* [*Delia antiqua*], *Heliothis armigera* [*Helicoverpa armigera*], *Agrotis ipsilon* and *Spodoptera litura*. Storage pests include *D. antiqua*, *Atherigona orientalis* and *Carpophilus obsoletus*.

1125 MAHESHWARI, SK; GUPTA, PC; SUHAG, LS. 1988. A note on the studies of the effect of different fungicides to control *Aspergillus* rot of onion caused by *Aspergillus niger*. Haryana Jrl. of Horticultural Sc., 17: 1-2, 127-129.

Hisar-2 onion seedlings were planted, inoculated with *A. niger* and treated with 1 of 4 fungicides a week later or treated with fungicide alone. Bulbs were harvested and stored in thin gunny bags at room temp. in a dry place. After 2 months disease incidence was recorded. The most effective control was achieved by Bavistin [carbendazim] followed by Difolatan [captafol], Blitox and Dithane M-45 [mancozeb]

1126 MAUDE, RB; BAMBRIDGE, JM; SPENCER, A; TAYLOR, JD; MUNASINGHE, HL. 1984. Storage rots of onions. 34th Annual Report for 1983 - National Vegetable Research Station. Wellesbourne, Warwick, UK. p. 64-66.

Aspergillus niger and *Penicillium spp.* were the main fungi isolated from post-harvest rots. Growth of 10 *A. niger* isolates was best at 32.5°C and reduced by more than half at 20 or 40°. That of 2 *P.* isolates occurred at 25° and ceased at > 35°. *Botrytis allii* grew best at 22.5° but there was virtually no growth at 30°. *A. niger* caused lesions when inoculated into wounded onion storage tissue held at 30° and RH > 80%. The wounded surfaces of topped onion necks and sides of the neck provided invasion points for *A. niger* and *B. allii*. At RH > 80%, onions inoculated with *B. allii* developed considerable neck rot when stored at 20° but not at 30°; the reverse was true for invasion of bulb necks by *A. niger*. Although a dense mat of *A. niger* mycelium and conidiophores developed inside the base of the neck, encrusting the tops of the fleshy storage scales, invasion of the scales themselves was not seen. Three times more bulbs developed bacterial rotting at 30° than at 20°. Probably the commercial practice of drying onions at 30° for 3-5 days followed by 25-30° for a longer period favours these high temp. fungi and bacteria. The fungi can largely be controlled by ensuring that the RH does not exceed 80%. Bacteria pathogenic to onion bulbs were isolated from most of the 50 onion stores sampled during 1980-83. Most were opportunists not normally considered to be plant pathogens and included *Erwinia herbicola*, *Lactobacillus*-like organisms and 3 different unidentified organisms. A similar range of organisms was isolated from bulbs sent from Africa and India, where high storage temps. are normal. *Pseudomonas [gladioli pv.] alliicola* has only rarely been found. All these organisms caused rotting when inoculated into healthy bulbs maintained at 30° or 35°, but with the

exception of *E. herbicola*, most did not cause rots below 25°. Modern crop practices such as mechanical topping and high temps. for drying and skin colour development provide ideal conditions for bacterial infection and development. The origin of these high temp. bacteria is not known but *E. herbicola* is widely distributed on onion leaves in the field. When isolates from apparently healthy onions were inoculated into stored bulbs many were found pathogenic.

1127 NETRA PAL; SINGH, N; CHOUDHURY, B. 1988. Correlation and path coefficient studies in onion. Indian Jrl. of Hort., 45: 3-4, 295-299.

Eight inbred lines of *Allium cepa* and 28 F1 hybrids derived from them by a diallel cross (excluding reciprocals) were evaluated for various morphological and biochemical characters. Yield was positively correlated with bulb weight and diameter, and plant height. Dry matter content was positively correlated with total soluble solids, pyruvic acid and total sugar and non-reducing sugar contents. It was negatively correlated with storage losses, drying ratio and reducing sugar content.

1128 NIDIRY, ESJ; CHANDRAVADANA, MV; RAO, MS; KHAN, RM. 1994. In vitro nematocidal activity of extracts of bulbs and seeds of onion against root-knot nematode *Meloidogyne incognita*. Nematologia Mediterranea (Italy), 22: 1, 37-40.

1129 OMVEER SINGH; ROY, AN; GUPTA, MEERA. 1987. Storage rot in bulbs of onion (*Allium cepa* L.) and its control. Pesticides, 21:6, 43-47; 12ref.

Maximum rotting of stored bulbs was caused by *Aspergillus terreus* and *Fusarium culmorum* at 30°C and 90% RH. Rotting was considerably reduced at temp. <25° and 30-50% RH. Of 18 treatments tested, Bavistin [carbendazim] and Benlate [benomyl] were effective when used as preventive treatments prior to storage.

1130 PATIL, RS; KALE, PN. 1985. Correlation studies on bulb characteristics and storage losses in onion. Journal of Maharashtra Agricultural Universities, 10: 1, 38-39; 8 ref.

In studies with 37 onion cultivars percentage total loss was positively correlated with neck thickness, bulb diam. (equatorial and polar), physiological weight loss, sprouting and rotting. Bulb weight was positively correlated with neck thickness, bulb diam. and rotting. Cultivars Seroli-1 and Adsuli-1, having a thin neck and moderate bulb weight, showed least storage losses and proved most promising.

1131 SINGH, J; DHANKAR, BS. 1991. Effect of nitrogen, potash and zinc on storage loss of onion bulbs. *Vegetable Science*, 18: 1, 16-23.

1132 SINGH, J; DHANKAR, BS. 1994. Effect of preharvest chemical treatment on storage loss of onion. *Advances in Hort. and For.*, Vol. 4/ edited by KL Chadha. New Delhi: Malhotra Pub.

1133 SINHA, P; SHARMA, RP; ROY, MK. 1994. Management of storage rot in onion through gamma-irradiation and chemicals. *Journal of Food Sc. and Tech.* - Mysore, 31: 4, 341-343.

Pre-harvest sprays of bavistin (50% carbendazim) at 100, 200 and 400 g a.i./ha were ineffective in the control of *Aspergillus niger* van Tieghem in onion. The combination of gamma irradiation (0.1 kGy) with bavistin dust (0.33g a.i./kg bulbs) was effective to an extent of about 79% in reducing storage losses due to sprouting and rottage. This combination treatment was better than dust treatment alone and highly cost effective. Bavistin, when used as pre-harvest spray, did not leave any residue in the tissues, whereas the compound was seen to move deep into the tissues, when used as post-harvest dust treatment. Higher concentrations of carbendazim residues (2.1-3.4 mg/kg bulb) were detected in the outer scales of the bulbs, as compared to that of inner scales (0.6-1.6 mg/kg), and the residue decreased slightly with passage of storage time.

CAULIFLOWERS

1134 DASGUPTA, S; DASGUPTA, J; MANDAL, RK. 1993. Cloning and sequencing of 5' flanking sequence from the gene encoding 2S storage protein, from two *Brassica* species. *Gene (Netherlands)*, 133: 2, 301-302.

1135 GOYAL, M; MATHEW, S. 1990. Physico-chemical characteristics of cauliflower dried under different drying conditions. *Indian Journal of Nutrition and Dietetics*, 27: 2, 39-46.

Cauliflower is available only during the winter season in most of India but can be made available throughout the year by drying. The effect of 3 methods of drying (open sun drying, shade drying, and by means of a solar drier), with or without blanching, on the quality of the dried product was investigated. All dried samples were analysed for proximate composition, ascorbic acid, water soluble sugar, tryptophan, iron, phosphorus, sodium, potassium and calcium. Results showed that blanching followed by solar drying produced the shortest

drying time, best organoleptic properties and the lowest nutrient losses.

1136 ROY, SK; KHURDIYA, DS. 1983. Standardizing the pretreatment for solar drying of cabbage. *Third Indian Convention of Food Scientists and Technologists*. Mysore: CFTRI.

1137 SINGH, KK; SHUKLA, BD. 1990. Drying, packaging and storage of cauliflower. *Proceedings of the International Agricultural Engineering Conference and Exhibition*. (Bangkok, Thailand : 1990: 3-6 December)/edited by VM Salokhe and SG Ilangantilebe. Bangkok: Asian Institute of Technology, p. 581-589; 4 ref.

A batch type mechanical dehydrator for cauliflower was developed and the results of trials are reported. Three types of packaging material, polypropylene (100 gauge), low density polyethylene (300 gauge) and a mixed component material, were used for the dehydrated cauliflower and m.c. at different temp. and RH during an 8 month storage period were measured. Results are discussed. The economics of small scale dehydration in rural areas of India and of employment generation are considered.

1138 VIJAY, S; ANAND, JC. 1984. Effect of mustard and its components on the fermentation of cauliflower. *Indian Food Pack.*, 34: 4, 41-46.

TOMATOES

Storage

1139 BALASUBRAMANIAN, T; SADASIVAM, S. 1983. Effect of temperature on biochemical components during storage of tomato fruits. *South Indian Horticulture*, 31: 2/3, 89-94; 14 ref.

Storage life at 27°C (70% of fruits still sound) was seven days for CO1 and 13 days for Marutham, an induced mutant of CO1. Storage life was extended by two weeks in CO1 and one week in Marutham by exposing the fruits to 33°C for four days prior to storage at 27°C. The lower pectinesterase activity of Marutham may have contributed to its longer storage life.

1140 DOIJODE, SD; RATURI, GB. 1990. Effect of hydration-dehydration on storability of tomato and radish seeds. *Indian Journal of Plant Physiology*, 33: 2, 172-174.