“Effect of post harvest treatment on shelf-life and quality of Langra mango”

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By

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Rewa (MP)

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CERTIFICATE- I

This is to certify that the thesis entitled, ***"Effect of post harvest treatment on shelf-life and quality of Langra mango"*** *submitted in partial fulfillment of the requirement for the degree of* ***MASTER OF SCIENCE IN AGRICULTURE (HORTICULTURE)*** *of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is a record of the bonafide research work carried out by* ***Mr. Dinesh Kumar Ahirwar*** *under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instruction.*

No part of the thesis has been submitted for any other degree or diploma (Certificate awarded etc.) or has been published/published part has been fully acknowledged. All the assistance and help received during the course of the investigation has been acknowledged by him.

Place: Rewa
Date: …. /…./….

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Chairman of Advisory Committee

THESIS APPROVED BY THE STUDENT'S ADVISORY COMMITTEE

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Member : (Dr. A. K. Singh) ……..

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CERTIFICATE-II

This is to certify that the thesis entitled, ***"Effect of post harvest treatment on shelf-life and quality of Langra mango"*** *submitted by* ***Mr. Dinesh Kumar Ahirwar*** *to the Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, in partial fulfillment of the requirement for the degree of* ***MASTER OF SCIENCE IN AGRICULTURE*** *in the* ***Department of Horticulture,*** *College of Agriculture, Rewa (M.P.) has been, after evaluation, approved by the External Examiner and by the Student's Advisory Committee after an oral examination on the same.*

Place : Rewa **(Dr. Rajesh Singh)**

Date : ……. Chairman of Advisory Committee

MEMBER OF THE STUDENT'S ADVISORY COMMITTEE

Chairman	:	(Dr. Rajesh Singh)	……
Head of Department	:	(Dr. Jagdish Singh)	……
Director of Instruction	:	(Dr. P.K. Mishra)	……

Layout plan

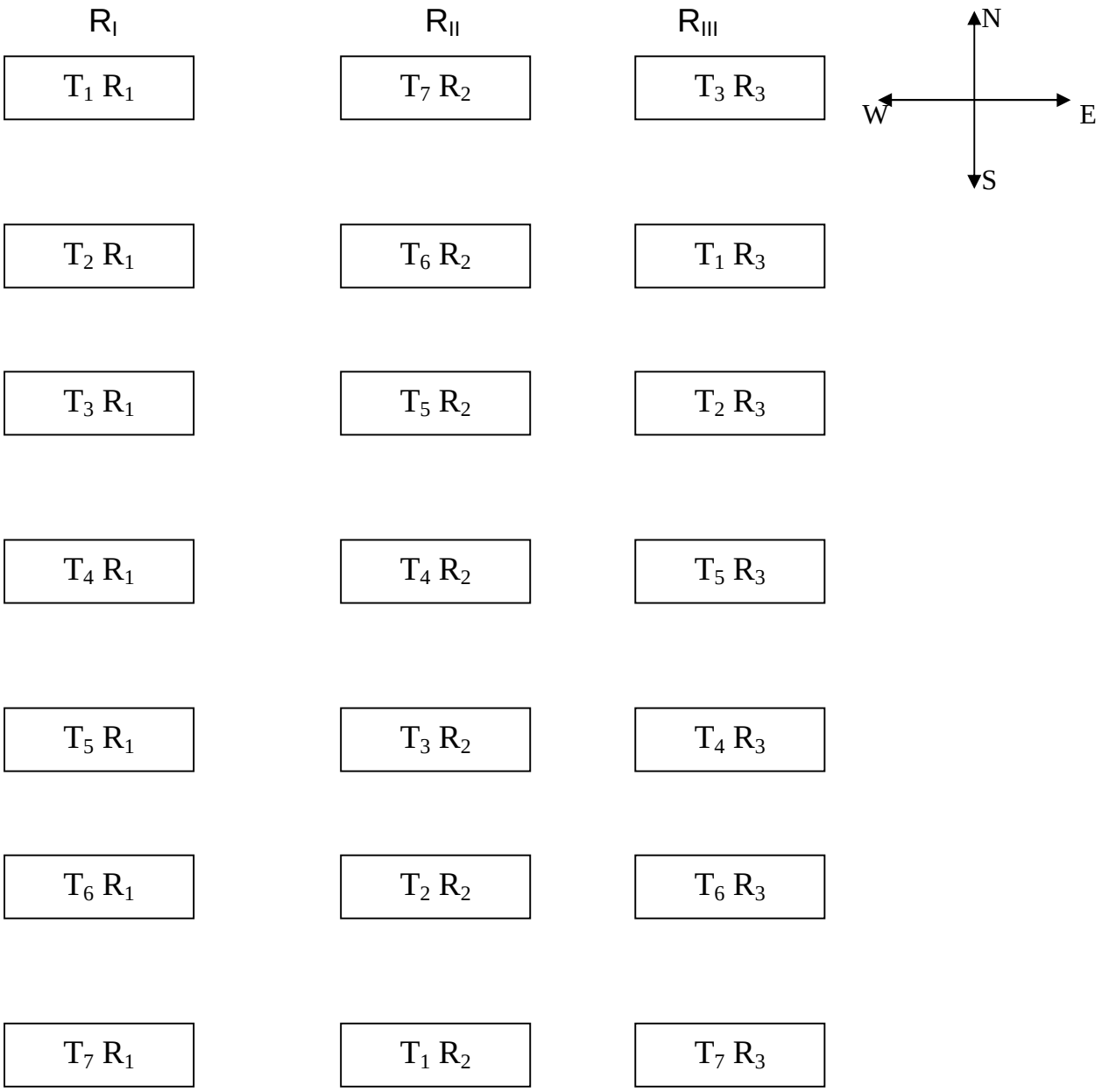

Fig. – 3.2 Experiment plan of Layout

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*Date : / /*2013 ***(Dinesh Kumar Ahirwar)***

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LIST OF ABBREVIATIONS

Words	Abbreviations
Analysis of variance	Anova
Calculated	Cal.
Centimetre	Cm
Co-Workers	et al
Critical Difference	C.D.
Degree of Freedom	d.f.
East – West	E-W
Error mean sum of squares	M.S.S.E.
Figure	Fig.
Fisher's value	'F' Value
Gram (s)	G
Hectare	Ha
Kilogram (s)	Kg
Maximum	max.
Mean sum of square	M.S.S.
Metre	M
Minimum	min.
Mililiter	Ml
Milligram	Mg
Non-significant	N.S.
North-South	N-S
Number	No.
Per	/
Per cent	%
Quintal	Q
Replication	R
Serial No.	S. No

Significant at 5% level	*
Source of variation	S.C.
Sum of square	S.Q.
Standard error of mean	S.Em ±
Standard error of difference	S.Ed.
Tabulated	Tab.
Temperature	Temp.
Treatments	T

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CHAPTER - I

INTRODUCTION

Mango (*Mangifera indica* L.) is the member of anacardiaceae family and it is one of the most commercial fruits of India. India ranks first in mango production. In India it occupies an area of 2, 35,607 thousand hectare is 42 percent area devoted to fruit crops and with a total production of 1,35,570 thousand million tonnes. In which Madhya Pradesh, occupies an area 16.3 thousand hectare and production is 146.6 thousand metric tonnes (Data base 2009-2010). Rewa region of Madhya Pradesh has great potentiality for mango cultivation; it occupies an area of 7202 hectare.

Mango is good source of nutrients. Mango pulp is the most important which is utilized for human consumption. Fruit pulp predominates in water, carbohydrates, fiber organic acids, fats, minerals, pigments, tannin, and vitamin. The ripe fruits pulp contains about 11.8 percent carbohydrates, 4800 IU of vitamin A and 13 mg/100 mg ascorbic acid. The pulp is a rich source of ß carotene; sucrose, glucose and fructose constitute the bulk of carbohydrates and most of the soluble solids in mango pulp.

Since matured mango fruits are climacteric and highly perishable in nature, they can hardly be stored for a week at ambient conditions after harvest and are highly susceptible to chilling injury, when stored below 8^0C extension in storage period of mango and other fruits has successfully been achieved with use of chemicals and growth regulators. Development of method to delay ripening would therefore be immense value in prolonging the shelf-life and increasing

the international marketing potential. However, varieties do not respond uniformly to these treatments.

The foliar application of micro-nutrients and plant growth regulators have very important role in improving the productivity and quality of mango fruits. This practice has also beneficial role in recovery of nutritional and physiological disorders in fruits trees grown under sodic soil conditions. Various trials have earlier conducted on foliar spray of micro- nutrients and plant growth regulators in different fruit species and shown significant response to improving yield and quality of fruits.

Qualities as well as storability of mango fruits depend much on the pre harvest treatments. Scare application of plant growth regulators and chemicals during the developmental stages results in poor storability due to increased rate of respiration and irregular biochemical function of fruit cell. Like other many fruits, mango is also perishable and after harvest spoil rapidly. Post – harvest losses in mango are estimated in the range of 25 to 40 percent. Pre-harvest factors are responsible for these huge losses to some extent. For the quality assurance in mango, pre and post harvest practices are necessary to minimize the losses. In this regard use of plant growth regulators and chemicals which affect ripening process directly or indirectly has been found very promising.

To ensure quality and shelf life of mango fruits with pre-harvest spray of chemicals and plant growth regulators has been tried by several workers. Advocated that the use of calcium compounds as pre-harvest treatment helps in retaining fruit firmness, decreases storage breakdown, rotting and browning. It also protects membranes

from disorganization and maintains protein synthesizing cells. Calcium compounds extend the shelf-life of several fruits by maintaining firmness minimizing the rate of respiration, protein breakdown and disease incidence. Calcium compounds have shown promise in the quality retention of fruits also.

Pre-harvest applications of GA3 have been reported to delay ripening, softening, colour development and occurrence of rind disorders in mango fruits. Use of GA3 as pre-harvest spray has also been found useful to enhance taste, flavour and organoleptic value of fruits. Pre-harvest spray of 10-15 ppm GA3 proved useful for on tree storage of mango by controlling maturity and delaying ripening.

The delay in ripening due to GA3 application might be owing to reduced degradation of chlorophyll, ascorbic acid, less carotenoid accumulation and decrease in enzyme activities.

Several genera of pathogenic fungi including *Colletotrichum, Gloesosporium* and Diploid are responsible for latent infection in mango. Latent infection of mature fruits may take place through lenticels. Soon after harvest these pathogen get free access through the stem end scar causing stem- end rot. In general, fruit become more susceptible to infection as they mature and ripen. With certain exception latent infections occurring in the orchard are difficult to control by fungicide treatment after harvest. However, such infections can be reduced by lowering the number of viable spore with pre-harvest spray of fungicides to prevent infection in the orchard.

Two pre harvest sprays of carbendazim (0.05%) a month in advance of harvesting are helpful in minimizing microbial load and post-harvest diseases and in uniform fruit ripening, better colour

development and prolonged shelf life of fruits Application of phenoxy compounds like 2,4-D and 2,,4,5-T reduce weight loss with the texture of pulp and prolong the shelf life of fruits.

The extent of post harvest losses in mango range stream 20 to 30%. The post harvest losses can be minimized by the extension of shelf life through checking the rate of transpiration and respiration, microbial infection and protection membranes from disorganization. This could be achieved by using the plant growth regulators, chemical hot water and different materials after harvest of fruits.

The fore said objectives can be achieved to some extent by use of growth regulator, wax emulsion coating, perforated polythene, use of fungicide, calcium treatment and silver nitrate and hot water treatment to enhancing the self life and quality of Langra mango. Keeping this in view, the present study was under taken at the Fruit Research Station, Kuthulia, College of Agriculture, Rewa during the year 2011 with the following objectives.

1. To enhance the shelf-life through checking the rate of microbial infection and protection membranes' by used of post harvest treatment.
2. To find out the post harvest causes by use of growth regulator, wax emulsion, perforated polythene, use of fungicide enhancing the self-life and quality of Langra mango.
3. To enhance the markebility of fruit for longer period without adverse affecting the quality.

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CHAPTER - II

REVIEW OF LITERATURE

Post-harvest treatment of fruits is one of the important cultural practices to check the decay and improve the storage life, marketability and colour development of fruits. Lot of work has been done and much more is required to be done in this direction. A brief resume of the findings of the former workers related to the subject has been reviewed which are mentioned in this chapter.

Conway and Sams (1985) indicated that uptake of calcium by fruits was markedly influenced by fruit maturity at the time of harvest. According to them , if the fruits are harvested and treated early, very little C_aCI_2 solution is taken into the fruit and little decay inhibition realized. If the fruits were harvested too late, however, more calcium taken up than needed for optimum decay control and severe fruit injury may result.

Siddiqui and Gupta (1989) studied the effect of pre-harvest spray of calcium on shelf life of Ber. Fruits of the cultivar Kaithli were sprayed with calcium nitrate at 10.3 q/litre and calcium chloride at 6.4 g/litre. The fruits were harvested at the colour- turning stage, packed in 4 kg wooden boxes and held at room temperature for up to 9 days. Data were tabulated on fruit weight loss, decay loss, ripening %, organoleptic rating, ethylene evolution acidity and ascorbic acid content. Weight loss on the 9^{th} day was 24.3- 27% in treated fruits and 14.3% in the control; the corresponding figures for decay loss were 2.12- 2.26% and zero (control). Organoleptic rating was similar

for calcium nitrate-treated and control fruits and low for calcium chloride – treated fruits.

Lu and Ouyang (1990) reported that bunches of grapes on cultivars Taifi Rose and Long Yan vines were sprayed with 0.5, 1.0 or 1.5% Ca $(No3)_2$ 10 days or 1 month before harvest, then bunches were stored in polyethylene bags for 122 or 33 days at 3-5^{0}C.The highest concentration , applied 10 days before harvest, reduced storage losses in Taifi Rose and Long Yan by 76 and 64% increased berry turgor pressure by 406 and 367 g and increased strength of attachment of berries to the stalks by 130 and 79 g, respectively. Treatments retarded losses in soluble pectin and changed the ratio of fructose; total acidity. They also reduced polyphenoloxidase activity and decreased the losses of tannins and ascorbic acid so that there was less internal browning of berries. The solute leakage was reduced and berry Ca content increased by up to 39%.

Khader (1991) found that application of GA_3 as pre-harvest spray on mango fruits cv. Dashehari at 100, 200, 300 and 400 mg/litre after fruit set retarded the ripening of mango fruits for up to 6 days of storage under ambient temperatures. With increasing concentrations , post – harvest ripening during the first 6 days was delayed significantly. Fruits that received @ 200 mg GA_3/litre, exhibited les total soluble (TSS), a lower TSS/acid ratio, less total carotenoids and lower amylase & peroxidase activity at harvest. Total acidity, ascorbic acid and total chlorophyll in peel were significantly higher in these fruits.

Satem and EI- khoreiby (1991) carried out a field study at the Suez Canal University, Ismailia during 1988-90, marsh seedless grape fruit trees were sprayed with 1 % C_aCI_2 and water (control) in mid August in both seasons. Mature fruits were harvested on 5 November 1988 and 20 November, 1989 and treated with 500 ppm thiabenazole, kept for 24 hour at room temperature and 60-70% RH, then treated with 1% C_aCI_2 or water (control) and placed in perforated polyethylene bags (5 fruits/ bag). The fruits were stored at 2, 5, 10 or 20^0C and 85-90% RH. Decreasing storage temperature resulted in lower weight loss and percentage decay. Treatment with 1% C_aCI_2 further reduced the weight loss and percentage decay. Fruits could be stored for 18 weeks at 2 and 16 weeks at 5^0C. the TSS : acid ratio at the end of storage increased with decreasing storage temperature with C_aCI_2 and storage at 2^0C.

Sandhu and Subhadrabandhu (1992) observed that pre-harvest sprays of GA3 at 100, 200 and 300 ppm, Vipul (triacontanol) at 500 ppm, C_aCI_2 at 4 and 6% and Bavistin (carbendazim) at 1000, 2000 and 4000 ppm were applied to fruits of cv. Kinnow. Increased fruit firmness and delayed colour break were obtained with 4 sprays of GA3 (300 ppm) or Bavistin (2000 ppm) applied on 5 and 25 November and 5 and 25 December. Fruit size, fruit weight and juice recovery increased with increasing GA3 concentrations but the amount of peel decreased. The highest rag percentage was obtained with C_aCI_2 . The treatments had little effect on TSS and acidity.

Sheikh *et al.* (1992) treated the mango fruits cv. Langra with 2, 4-D (50 and 100 ppm) and Cycocel (chlormequat) (250 and 500

ppm) during 1987-89. After treatment fruits were analysed physically during room storage (day temperature 40.2^{0}C and night temperature 26.9 ^{0}C). The analysis was repeated 4 times at 4 day intervals. Weight loss , skin and pulp colour development and wrinking were lowest treatments with 50 ppm 2,4-D and 500 ppm Cycocel. However, fruits from these treatments showed the poorest organoleptic values during the initial period of storage but were judged better than fruits from the other treatments after 16 days of storage

Kumar and Singh (1993) found that pre-harvest sprays of GA3 (50 and 75 ppm) and Ethrel (ethephon) 500 ppm) on mango cv. Amrapali brought forward fruit maturity by 8-11 days and ripening by 10-14 days compared with controls, significantly improved fruit quality (TSS contrent, sugar, ascorbic acid and beta carotene concentrations) and reduced spoilage losses during storage without causing a marked increase in pre-harvest fruit drop. There was virtually no fruit fly damage with plant growth regulators treatment.

Naqvi (1993) reported that dacay caused by *Botryodipodia theobromae* and *Colletorichum gloeosporioidies (Glomerella cingulata)* was best controlled by 3 pre-harvest sprays of benomyl at 15 days intervals. Carbendazim and thiophanate methyl were also effective when used at the recommended rates. Moreover when used at the recommended rates these fungicides left residues within the permitted safety levels.

Raese and Drake (1993) conducted trials over several seasons and stated that fruits from apple (cultivars Delicious and Golden

Delicious) and pear cv. Anuj (Beurred' Anuoj) trees sprayed with C_aCI_2 - 3 week intervals from June until late August then stored for up to 10 months at 0^0C had Ca concentrations at least 10% higher than those of unsprayed control trees. In apples, C_aCI_2 sprays (at 1.36 or 1.8 kg of 94.97% pure C_aCI_2/378 liters of water) substantially reduced the incidences of bitter pit scald and internal breakdown and also generally increased fruit firmness, total acidity and juice texture rating, compared with controls. In pears, C_aCI_2, C_aCI_2 + Regulaid (a propane derivative adjuvant), stopit or Nutrical sprays (at 0.9 kg C_aCI_2/ 378 litres of water) all reduced the incidence of cork spot, but only Nutri- Cal and C_aCI_2 + Regulaid resulted in significant increases in fruit firmness. Leaf damage caused by spraying, on a scale of 1 (very slight) to 5 (very severe) ranged from 1.8 with $C_aCI_2$or Regulaid to 2.4 with Nutri-Cal. In one year of the trial C_aCI_2 sprays increased pear fruit yield by 36 % compared with controls.

Singh *et al.* (1993) noticed changes in post harvest quality of mangoes affected by pre-harvest application of calcium salts. Twelve years old mango cv. Dashehari trees were sprayed with water, Ca $(N0_3)_2$ (1 or 2 % Ca_2^+) or C_aCI_2 (0.6 or 1.2% Ca_2^+) 20 and 10 days before harvest. Fruits were stored under ambient conditions (35.3 ^0C and 65.5% RH). All Ca treatments delayed ripening and improved fruit quality during storage. C_a treated fruits contained more Ca in the peel and flesh, loss less weight and had a lower respiration rate than control fruits. Fruits from the treatment (0.6% Ca_2 + as $CaCI_2$) could be stored for 10 days. For the other Ca treatments this was 8 days , while the control fruits were over ripe by this time. Treatment with

1.2% Ca_2 + as $CaCl_2$ caused marginal and lamellar scorching of leaves. Control fruits could be stored for only 6 days.

Tripathi and Bhargava (1993) observed the effect of pre-harvest treatment of fungicide and chemicals on the post-harvest behaviour of red delicious apple in air cold storage trees of red delicious were sprayed twice in July , 2 weeks apart , with 0.5% $CaCl_2$, 0.05% Bavistin (corbendazim), Difolatan (captafol) or a combination of 0.5% $CaCl_2$ + 0.05% Bavistin + 0.1 boric acid. Fruits were harvested on 10 August and 9 September and placed in air cooled storage for up to 150 days. There was a gradual reduction in flesh firmness as the storage duration increased. Maximum firmness after 150 days 911.18 ib/inch^2) was found in fruits from trees sprayed with 0.05% $CaCl_2$, alone. Fruits from the earliest harvest retained firmness best. The fruit TSS content was highest with the treatment with Bavistin alone and lowest with $CaCl_2$, alone. It was higher in fruits harvested on 9 September than in the earlier harvest fruits. Titratable acidity decreased with time, being highest after 150 days in fruits from trees sprayed with $CaCl_2$, alone. The Bavistin treatment resulted in the highest total sugars content, followed by the control (unsprayed trees-treatment with $CaCl_2$, alone or with the combination spray resulted in the lowest content. The most attractive fruit colour was associated with the combination spray and fruits from the second picking. The $CaCl_2$, treatment was almost as effective.

Wasker *et al.* (1994) conducted an experiment with cv. Thompson seedless grapevines grown in an vineyard at Rahuri. Plants were sprayed with $CaCl_2$,(0.6 or 1.0%), 10 days prior to

harvest. The parameters measured were fruit TSS, acidity and reducing sugar and non- reducing sugar concentrations at harvest and after 4, 8 12 and 16 days of storage in boxes under ambient conditions. Physiological weight loss during storages was also determined. Grapes treated with 0.6 percent $CaCI_2$, had a longer shelf life than the untreated controls (16 and 10 days, respectively), This treatment also gave the highest organoleptic rating and the lowest level of physiological weight loss.

Galvis and Hernandez (1994) also observed the effect of calcium chloride in the storage of mango following a preheating treatment (immersion in water at 46^0C for 55 minutes),, mango cv. Tommy Atkins fruits were emerged in 15, 20 or 25% (by weight) $CaCI_2$, solution at 6 for one hour. Controls were not treated with $CaCI_2$. After this fruits were dried, packed in boxes and stored at 10 and 90% RH during which weight loss respiration ^{0}Brix,pH and acidity were determined regularly. The best results were obtained with 15% $CaCI_2$, which resulted in the longest storage period (38 days), while allowing fruits to fully mature. The highest $CaCI_2$, concentration inhibited normal fruit development and maturation.

Mahajan and Sharma (1995) recorded the effect of post – harvest application of calcium chloride on storage behaviors of mango cv. Dashehari Calcium chloride (2, 4-, 6 and 8%) was used to treat stored mangoes (cv. Dashehari).Treated fruits were packed in wooden boxes and stored at room temperature (30.2^0C and 60-65% RH). Calcium chloride (6%) was the most effective in reducing weight losses and improving colour and quality. Fruits treated with this

concentration were marketable after 12 days of storage as compared to 7 days in control fruits.

Singh *et al.* (1995) conducted an experiment to study the effect of pre-harvest spray of GA3 and Ethrel (ethephon) were sprayed on the fruits in the first week of June 1990 to enhance the ripening and improve the storage life of Amrapali mango fruits. Ethrel at 500 ppm was very effective in enhancing the ripening and improving the quality in terms of TSS, total sugar, ascorbic acid and ß carotene content. Treated fruits also escaped attack by fruit-flies. Ethrel at 750 ppm improved the quality of fruits but enhanced fruit drop.

Zambrano and Manzano (1995) investigated the effect of Ca on the ripening of mango (cv. Haden) fruits (harvested in Venezuela). Fruits were either dipped in $CaCI_2$,for 2 hours or $CaCI_2$, was infiltrated into fruits for 10 minutes. Fruits were stored at 15^0C, 90 % RH. Ca treatment extended storage life by a week. Quantification of released ethylene and concentrations of sugars, ascorbic acid alcohol-insoluble solids and starch indicated that post- harvest application of Ca_2 + slightly delayed ripening. The physiological weight loss was lower in Ca- treated fruits.

Narayan *et al.* (1996) reported the effect of pre-storage treatments on shelf life and respiratory behaviour of ripe Baneshan mango. Uniform fruits of mango cv. Baneshan were given the following pre-storage treatments: (i) dipping in 500 ppm Bavistin (carbendazim) at 52^0C for 5 minute; (ii) stem –end waxing with molten wax; (iii) bagging in 10 cm. HM-film with 0.48% ventilation; (iv)

combination of (i) and (ii); (v) combination of (i) and (iii); (vi) combination of (ii) and (iii); (vii) combination of (i), (ii) and (iii) control (no pre storage treatment). Fruits were then stored under ambient conditions (29.11-33.81^{0}C). The shelf life of untreated fruits in these conditions was 4,6 and 9 days, respectively. Treatment (vii) was most effective in extending shelf life, increasing it to 8, 12 and 23 days in the different conditions, respectively. Treatment (vii) resulted in the lowest respiration rate in ripe fruits.

Rao *et al.* (1996) reported that the effects of pre-harvest applications of 2,4-D (20 and 40 ppm), kinetin (10 and 15 ppm). Bavistin (carendazim, 500 and 1000 ppm) and maleic hydrazide (500 and 1000 pm) were evaluated on shelf life of sweet orange cv. Sathgudi at ambient temperatures (34-36^{0}C). Kinetin at 15 ppm followed by Bavisin at 1000 ppm reduced the weight loss significantly, resulted in the highest percentage of sound fruits even after 18 days of storage and extended the shelf life. 2,4-D and MH sprays were less effective.

Zhou *et al.* (1996) observed the effects of exogenous ABA, GA3 and cell wall degrading enzymes activity carotenoid content in ripening mango fruit and found that during ripening, polygalacturonase (PG) activity increased significantly then declined, while pectinesterase (PME) activity gradually decreased. Post harvest treatment with ABA caused an increase in PG activity, but GA3 treatment delayed the peak of activity. Neither ABA nor GA3 had a consistent effect on the changes in PME activity during ripening. GA3 treatment reduced the rate of carotenoid increase in contrast to

ABA which increased it throughout ripening post harvest treatment with beta-carotene increased PG activity in ripening fruit. The possible relationship between colour development and PG activity was discussed.

Bhatt *et al.* (1997) conducted an experiment to see the effect of pre-harvest sprays of calcium and potassium of fruit quality characteristics of cherry cv. Makhmali revealed that calcium chloride sprays reduced and potassium chloride used the fruit weight vis-avis their dimensions. However, calcium chloride sprays had no effect on fruit yield, potassium chloride treatment at 1.5 and 2.0 percent level significantly increased fruit yield and juice content. Pulp/stone ratio also increased with potassium treatments. Both calcium and potassium treatments reduced cracking index, but increased total sugars and ascorbic acid content. Application of 2.0 percent spray calcium and potassium chloride significantly increased TSS and anthocynin contents.

Brar *et al.* (1997) carried out an investigation at Ludhiana, India to study the effect of pre-harvest sprays of calcium nitrate on the storage life of Shan-I Punjab peach. Calciumnitrate (1.0, 1.5, 2.0 or 2.5%) was applied 3 times at weekly intervals (15, \22 and 29 April) before harvest. The harvested fruits were kept in cold storage at 3.0-3.5^{0}C, 85-90% RH, for 22 days. Calcium nitrate at 2.5% resulted in minimum spoilage and physiological weight loss, reduced organic acid, fruit firmness and juice losses and increased total soluble solids and sugar contents.

Ladaniya (1997) noted the effect of pre-harvest application of GA3 (10, 15 and 20 ppm) on physico-chemical characcteristics of Nagpur mandarin during holding of fruit on the tree as well as on losses during post harvest storage at ambient and refrigerated conditions. GA3 treatments (10 , 15, 20 ppm) delayed rind colour development and fruit softening and minimized fruit drop and puffiness during on tree storage without adverse effect on T.S.S./acid ratio and fruit productivity in subsequent years. Fruit weight loss was reduced in storage by GA3 treatment, however, results were in consistent.

Ravi *et al.* (1997) conducted a trial to find out the shelf life of guava fruits, thirty years old guava cv. Sardar trees were sprayed pre- harvest with calcium nitrate (1 or 2%), calcium chloride (1 or 2%) NAA (100 ppm) , Cycocel (chlormequat) (1000 or 1500 ppm), calcium nitrate + NAA (1% + 100 ppm, respectively, or 2% + 200 ppm) calcium nitrate + Cycocel (various concentrations) . or were untreated. The best shelf life at ambient temperature was obtained with pre-harvest application of 2% calcium nitrate.

Saraswathi and Azhakiamanavalon (1997) reported that the effects of post harvest dipping of mandarin fruits in 2, 4-D (100, 250 or 500 ppm) GA (50,100 or 200 ppm) or Ethrel (ethephon) (100, 500, 1000, 1500 or 2000 ppm) at 12.5- 30^0C reduced percentage physiological weight loss and promoted storage life.

Kumar (1998) conducted an experiment on extending the post harvest life of fruits of mango cv. Sipia. The results revealed that the fruits stored at room temperature, all the treatments showed higher

ripening index values than the control. The 250 ppm, GA3 treatment was most effective in delaying the ripening during storage and minized weight loss. The Bavistin (500 ppm) proved effective to reduce fruit-rot TSS and carotenoids increased while acidity and ascorbic acid decreased steadily with increasing duration of storage irrespective of treatments. Among all the treatments, 250 ppm GA3 and 500 ppm Bavistin alone and in combination retained the highest marketable value, organoleptic rating with consumers acceptability.

Singh *et al.* (1998) reported that the shelf life of mango fruits cv. Amrapali was enhanced by pre-harvest spray of calcium compounds and stored in perforated polythin bags as judged from the pattern of physiological weight loss and higher TSS, acidity, total sugar, ascorbic acid and ß carotene content. Perforated polyethylene wrapping, C_aCl_2 (1.5%) and Ca $(NO_3)_2$ 15% were most effective treatments over the control to enhance the storage life of fruits.

Ziao *et al.* (1998) found that application of Ca $(NO_3)_2$ (0.0, 0.2%, 0.5%, 1.0% or 1.5%) + NAA at 10 mg/litre as foliar spray to plants of strawberry cv. Hani, spaced at 28 cm x 20 cm, after flowering in 1994-97. Harvested fruits packed in 0.04 mm thick polyethylene film bags (2-3 kg per bag) and stored at 20-25/ 14-18^{0}C (day/night) and 60-80% RH. After 5 days of storage, fruit rot indices of fruits treated with C_a $(NO_3)_2$ at 1.0, 0.5, 1.5, 0.2 and 0% (control) were 40, 58, 82 and 100% respectively.

Yahia and Campos (2000) reported that the hot water treatment (46.1 degrees C for 65, 75 or 90 minutes, depending on fruit weight) has been used in Mexico and other mango growing regions as an

insect quarantine treatment for the last 8 years. This study was conducted to evaluate the effect of this treatment on the ripening and quality of mango fruit. Fruits of the cultivar keitt were treated in hot water at 46 degrees C for 0, 60 and 90 minutes, and evaluated after 7, 14 and 21 days, storage at 10 degrees C, and subsequently after one week at 20 degrees C. Respiration rate, texture losses, polygalacturonase activity, and carotene content increased, while the pectin methyl esterase and lipoxygenase activities decreased. Water loss increased during storage and was highest as the treatment duration increased. However, fruits did not present any shrivelling nor any injury due to the treatment, and decay was reduced . It was concluded that hot water treatment increased the speed of ripening but did not cause injuries in keitt mangoes.

Singh *et al.* (2000) evaluated the efficacy of GA3 and plant extracts on shelf life and quality of mango cv. Langra fruits. The treatments consisted of a control, GA3 at 500 and 1000 ppm, and neem [Azadiracta indica] leaf extract, onion extract, castor oil and neem oil, each at 10% concentration. The fruits were dipped in the respective treatments for 5 minutes , air dried and finally packed in ventilated corrugated cardboard boxes having newspaper linings and tissue paper shreads as cushioning material. Physiological loss in weight showed an upward trend irrespective of treatments. Neem oil showed the minimum physiological loss in weight (7.77%) closely followed by castor oil (8.35%) and GA3 at 1000 ppm (9.87%). Fruits in the control showed maximum physiological los in weight (17.28%) on the 12^{th} day of storage. Spoilage percentage showed an

increasing trend in all the treatments. None of the fruits decayed up to the 6th day of storage at room temperature. Post harvest application of neem oil showe dthe minimum decay loss of 9.98% followed by castor oil (13.30%) and GA3 (13.30%). The spoilage organisms associated with decay were Botryodiplodia theobromae and Aspergillus niger. The infestation of these microoraganisms were were prevented by the antiseptic and antifungal action of neem oil. A sharp fall in firmness in all the treatments was observed during the storage period. Yet edible firmness was retained favourably in fruits treated with neem oil (3.00). Application of GA3 at 500 ppm recorded the maximum organoleptic rating during the storage. Castor oil did not fare well due to the obnoxious smell and patchy appearance on the fruit. The total soluble solids increased with increasing period of storage irrespective of treatments. Acidity showed a reverse trend in all the treatments.

Jain *et al.* (2001) carried out experiment where mango cv. Langra fruits that had been washed with tap water, air dried and treated with Benguard (0.05%) to control fungal infection and were dipped for 2 minutes in aqueous solution of wax emulsion (4,6 and 8%), calcium nitrate (0.5, 1.0 and 1.5%) and GA3 [gibberellic acid] (100, 200 and 300 ppm]. The control fruits were dipped in distilled water for the same period of time. The post harvest application of wax emulsion (8%) and calcium nitrate (1.0%) in combination with cool chamber storage markedly reduced the rate of ripening and helped to retain the quality characteristics of fruits during storage. At the end of the storage period , minimum total soluble solid, total sugar, and

reducing sugar contents and maximum acidity were recorded for wax emulsion (8%) + cool chamber storage. Maximum ascorbic acid and highest organoleptic score were obtained with calcium nitrate (1%) + cool chamber storage.

Reddy and Haripriya (2002) conducted a laboratory experimetn to test the efficiency of certain postharvest treatments using fungicide (carbendazim), growth regularors (GA3, maleic hydrazide and 2, 4, 5-T) and subsequent storage in polyethylene bags with ethylene scrubbers, or the wrapped fruits in wooden boxes on the shelf life and quality of mango cultivars Bangalora and Neelum at room temperature. Among the subjected treatments, GA_3 (200 ppm) treated fruits stored in ventilated polyethylene bags with ethylene absorbent significantly reduced the physiological loss in weight, rate of respiration, delayed colour development and ripening and had longer shelf life. Besides , the fruits also exhibited better quality on account of its favorable effect on slower increase in total soluble solids, sugars and retaining more acidity thereby rendering them acceptable up to a period of 8 days in Bangalora and 17 days in Neelum. The other treatment with 1000 ppm 2,4, 5-T and stored in similar condition as above was the next best treatment.

Dhemre and Waskar (2003) harvested the freshly mango (cv. kesar) fruits and were subjected to treatments of wax, wax coupled with carbendazim (0.1%) and captan (0.2%). These fruits and untreated lot (as control) were kept for storage at room temperature (24.18- 30.57 degrees C with 47.50 – 74.00% RH) and in cool chamber (21.36- 23.15 degrees C with 87.00-91.50% RH). Results

indicated that the fruits treated with wax coupled with carbendazim (0.1%) could be kept up to 26 days in cool chamber as against 20 days at room temperature. Data on shelf- life, physiological loss in weight (PLW), total soluble solids, acidity and total sugar indicated that the cool chamber might be an ideal on – farm storage facility for maintaining quality and market acceptability of mango.

Kalloo (2003) mentioned that pre-harvest spraying with calcium compounds prolonged the storage life of grapes. Spraying of 1.0% calcium nitrate 10 days before harvesting reduced the desiccation and decay in grapes.

Sharma *et al.* (2003) carried out an experiment to study the effect of foliar application of $ZnSO_4$ (0.25 and 0.5%) 2, 4,5-T (10 and 20 ppm) and GA3 (25 and 50 ppm on quality of kagzi lime. All the chemicals were applied individually and $ZnSO_4$ was also combined with 2, 4, 5-T and GA3. All the chemicals significantlyaffected the physico-chemical composition of fruits . Application of 0.5 percent $ZnsO_4$ + 20 ppm 2,4,5-T increased the fresh weight, volume and number of seeds per fruit while maximum juice was found with 0.5 percent $ZnSO_4$ + 50 ppm GA3. Combined application $ZnSO_4$ (0.5%) with 2,4,5-T (20 ppm) significantly increased the acidity and ascorbic acid while highest TSS was recorded with 20 ppm 2,4,5-T.

Choudhary *et al.* (2003) carried out an investigation to study the effect of certain chemicals on Sapota fruits variety Pala subjected to various pre- and post-harvest treatment such as Topsin M (0.1 and 0.2%) Bavistin (0.1 and 0.2%) $CaCI_2$ (1 and 2%) GA3 (100 ppm and 200 ppm) and water. All the treatments responded well in extending

the shelf life, reducing physiological los in weight and rotting as well as augmenting biochemical attributes such as TSS acidity as pre-harvest spray and post harvest dip. The fruits stored in 100 gauge polythene bags with 1-2% vent in paper cartoon was found best in increasing shelf life of fruits.

Gautam *et al.* (2003)conducted a study a Rajendranagar (Hydrerabad) to investigate the effect of various post-harvest treatments on ripening , shelf-life and quality of Banganapalli mango. The various post-harvest treatments included were fruit dip in hot water, $AgNO_3$ MH, NAA, $CaNO_3$ wax emulsion, storage with $KMnO_4$ with Silca gel. Treated fruits were stored under zero energy cool chamber (ZECC) and under room temperature. The fruit treated with Bavistin (0.1%) and stored under ZECC and cold storage conditions delayed the ripening to maximum extent. The potassium permanganate silica get treatment and ZECC storage was most effective in delaying the spoilage of the fruit. The chemical composition namely TSS, TSS/acid ratio, reducing non- reducing and total sugars were in general low in treated fruits. However, total titrable acidity and ascorbic acid content were higher. Further , the fruits dipped in 6% was emulsion and stored under ZECC conditions recorded greater shelf-life compared to other post harvest treatments.

Singh *et al.* (2003) selected for study twenty five year old Le Conte pear trees on wild pear root suckers, planted 5 m x 5 m apart at Ragional fruit research station , Bahadurgarh (Patiala) PAU. The trees were sprayed at midbloom during 1997 and 1998 by 15 PBR's treatments comprising gibberellic acid (GA3) and naphthalene acetic

acid (NAA) @ 5 and 10 ppm each, chloramequat (CCC) and Alar (SADH) @ 500 and 1000 ppm each , boron @ 100 and 200 ppm, cobolt chloride ($CoCI_2$) @ 10 and 20 ppm, sucrose @ 2.5 and 5.0 percent and control (water spray). Application of gibberellic acid (GA3) 5 ppm in Le Conte improved the fruit set and yield during the first year, whereas CCC 1000 ppm was more effective in the following year. The physico-chemical characteristics of the fruits were not affected consistently by the application of PBRs and nutrients during both the years.

Saini *et al.* (2004) carried out investigation on 20 year old trees of cv. Kagzi planted at 8 mm x 8m distance and growing in the experimental orchards of CCS HAU Regional Research Station , Bawal during 1999 and 2000. Three micro –nutrients viz. Zn, fe and B; two plant growth regulars viz. NAA and 2, 4-D and two soil amendments viz. FYM and gypsum, each at two concentrations/ dosage were applied. The fruit weight was not affected by any of the treatments . Fruit yield was increased by all treatments over control except NAA and gypsum. Maximum yield was observed under 0.1% borax, which was at par with 0.05% borax (112.60 kg/tree), but significantly higher than all other treatments. Improvement in yield by micro-nutrients has also been reported by Jadav *et al.* (1979) and Kumar *et al.* (1988). Improvement in yield due to micro – nutrients and plant bio regulators might be attributed to reduction in fruit drop and better availability of nutrients and growth regulators particularly the auxin, which play an important role in fruit growth and development. Total soluble solids and total sugars were increased by

all treatments except 2, 4-D and gypsum, when compared with control . Maximum TSS and total sugars were recorded under 0.1% borax and NAA 10 ppm, respectively. These findings are in close conformity with those of Bambal (1987) and Kumar *et al.* (1988). Acidity of the fruits did not shw any appreciable change.

Rangel *et al.* (2004) determined the study the effect of storage conditions and waxing on the water status and postharvest quality of mango fruits. Hydrothermal treated fruits were divided on two sets: one waxed with a commercial wax (Britex), and the other un-waxed as the control. Waxed and un-waxed fruits were stored under three different water vapor pressure deficit (VPD) conditions, 1.52, 1.114 and 0.22 KPa, during 10 days at 24 + or -1 degrees C. Daily and cumulative weight loss, firmness, relative water content (RWC), water potential (Psi W), osmotic potential (Psi s), pressure potential (Psi p) and soluble solid content (degrees Brix) were determined. Weight loss increased directly poportional to VPD. Wax application was effective in reducing by 30% the weight loss , but only at high VPD. Using daily weight loss and DPV conditions, empiric models were generated to predict shelf life on control and waxed fruits (r2= 0.90). When fruits reached 89% RWC and Psi p=0 (cellular plasmolysis), the commercial quality was still unaffected. Fruits with 84% RWC, Psi,0, and firmness=20 N, defined the beginning of commercial quality loss . Psi W was reduced during storage from – 1.0 to 2.8 MPa , depending on VPD conditions and wax application; this reduction was partially due to solute accumulation (degrees Brix) that

modified Psi s. As degrees Brix increased, Psi s descended in a lineal relation , a relation that can also be used for prediction.

Jayachandran *et al.* (2005) studied at the Model Orchard, College of Agriculture, Rajendranagar, Hyderabad during 1999-2000 on fifteen year old Lucknow 49 trees of uniform vigour. Seven treatments including control were laid out in a factorial randomized block design with three replications. The treatments include three different sources of calcium viz., calcium chloride, calcium nitrate and calcium sulphate at concentrations of 0.5 and 1.0% each. They were uniformly sprayed on the trees in the early morning hours, 15 days before harvest. Teepol (0.1%) was used as surfactant. Pre – harvest spray of calcium compounds reduced physiological loss in weight and titratable acidity, while they increased TSS, reducing sugar and pectin contents. However, higher concentration of calcium nitrate was more effective than other treatments. The fruits firmness increased as the concentration of calcium increased in the fruits. Calcium nitrate delayed softening and enhanced the shelf-life of fruits.

Rajkumar *et al.* (2005) conducted a study in order to examine the efficacy four levels each of $CaCI_2$, Ca $(NO_3)_2$ (1 & 2%, 3% and 4% each) and GA3 (50, 100, 150 and 200 ppm) on the post-harvest behaviour of papaya fruits. Uniformed size fruits were harvested at the physiological maturity and treated in various treatments for 5 minute at room temperature. The post-harvest treatment of papaya fruits in GA3 @ 100 ppm and $CaCI_2$ @ 2% recorded significantly the lowest level of loss in fruit weight, ripening percentage and rate of decay and have registered high firmness , high TSS, high ascorbic

acid content , titrable acidity and also higher score for sensory evaluation. The study suggests that both GA3 @ 100 ppm and $CaCl_2$ at 2% as post – harvest could preserve the physiological changes and improve the shelf- life up to nine days and the quality in papaya.

Sharma *et al.* (2005) conducted the experiment at Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu during the year 2001-2002. Fourteen years old Dehradum litchi trees of uniform vigour and size, planted at 9 m x 9m and maintained under uniform cultural practices were selected for the study. Eleven treatments comprising of Napthalene acetic acid (NAA) at 2.5 and 5 ppm, gibberellic acid (GA3) at 5 and 10 ppm, succinic acid 2, 2-dimethyl hydrazine (SADH) at 500 and 1000 ppm , boron (as boric acid) at 100 and 200 ppm . Application of NAA @ 2.5 ppm increased the initial fruit set, while the highest final fruit set was obtained with 200 ppm zinc. Zinc at 100 ppm was found most effective for increasing fruit weight, length, diameter and L/D ratio. SADH 1000 ppm proved to be the most effective treatment in increasing TSS. total and non-reducing sugars whereas ascorbic acid content increased with 100 ppm NAA.

Malik and Singh (2005) dipped mature green mango (Mangifera indica L. cv. Kensington pride') fruit for 6 min in aqueous solutions containing different concentrations (0, 0.01, 0.5, 1.0 mM) of various polyamines (PAs) including spermine (SPM), spermidine (SPD) and putrescine (PUT), with 0.01%' T ween – 20' as a surfactant and investigated their effects on shelf- life and fruit quality. Treated fruit were air dried (22 degrees + or 1 degrees C), packed in " Ecopax"

trays and stored in a cool room (13 +or + or +1 degrees C, RH 85 + or -5%) for 3 or 4 weeks. Following storage , fruits were allowed to ripen to the “eating soft” stage (score 4) at ambient temperature (22 degrees + or -1 degrees C). Pre- storage dip application of PAs retarded development of mean fruit softness (10.3%) and visual colour (26.3%) and reduced weight loss (6.8%) during storage without significant (p, = 0.05) reductions in ethylene production and respiration rate. During ripening of 3 week- stored fruit, 0.5 mM SPM-treated fruit exhibited significantly (p,0.05) lower mean respiration rates compared with the control. Application of PAs significantly (p,0.05) increased fruit firmness and ascorbic acid content , while reducing carotenes, total soluble solids (TSS)/ acid ration and Hue angle of ripe fruit compared with the no PA treatment. In conclusion , pre- storage dip application of PAs improved the shelf –life of mango fruit without impairing fruit quality.

Ahmad *et al.* (2005) found that the application of bavistin (0.05%) + PE packing of four fruits in 9 unit proved to be efficient treatment in reducing weigh loss of know followed by sta-fresh 960 (100%) the ascorbic acid content registered a gradual decline with the advancements in storage period in all treatment and storage system packaging of four fruit in on e PE bag after 0.05% bavistin treatment fallowed by 100% wax emulsion recorded maximum retention of ascarbic acid content as compared to ather treatment on the other hand minimum spoilage was observed in fruit treated with star-fresh 960 (100%) & bavistin (0.05% + PE packing of four fruits.

Madhavi *et al.* (2005) reported that the sapota fruit treated with ethrel exhibited higher TSS acid ratio than the control. This could be due to higher TSS and lower acidity observed in ethrel treated fruit which in turn due to accelerated ripening ethrel treated sapota fruit in general recorded higher as ganoleptie scores among the ethrel concentration tried 1000 ppm was found superior to other concentration.

Deka *et al.* (2006) found that the 13.95% of khasi mandarin fruit gets damaged during the process standing marketing in orderto reduce losses standariation of maturity indices and post harvest treatment are very much required for khasi mandarin asit is one of the most important commercial fruit crop of north east India the fruit harvested at 230 days after flowering had all the desirable quality however the fruit harvest at 250 days after flowering were also good in respect of some parameter days after flowering (230-2150 TSS) (< 10^0 Brix) juce content (> 493.0%) and TSS. acid ratio (>12.0) might be considered as suggested maturity indices far khasi mandarin.

Jholgiker and Reddy (2007) reported that the application of edible coating material like sago arrowroot and waxol at 10 percent concentration to Annona squamosa L. fruit resulted in increase in shelf- life by 5-8 day when compared to untreated fruit the fruit treated with fine coating of sago (10%) and stared in Zeroenergy cool chamber registered gradual ripening retained excellent fruit quality with high TSS. Sugar (total and reducing) acidity and ascorbic acid even up to ninth day of storage therefore identification of natural products which produces desirable coating material with necessary

amendment is the appropriate technology that can be explored for improving post harvest storage and marketing efficiency.

Fageria *et al.* (2007) reported that the Ber fruit treated with 5% $KMnO_4$ packed in sealed polythethylence bags were of acceptable quality with highest score as compared to lowest score in control fruit were acceptable only up to 4^{th} day of storage possible reason for the prolonged self-life with better quality of fruit in sealed poly ethylene gabs maybe due to the furgidity maintenance besides oxygen , depletion and CO_2 increase occurs which creates modified atmospheric condition in polyethelen packaging reaching equilibrium as a result he respiration activity is slowed down further lowered O_2 and increased CO_2 are not of favourable to athylene action application of chemicals act as ethylene absarbent which consequently retarded the actividies of catalase pectin methylesterase & ethylene reducing the ripening process.

Singh *et al.* (2007) carried out the experiment o nthirteen years old plants of anola cv. NA-10, uniform in vigour and growth were planted under sodic soil conditions at Main Experiment Station , Department of Horticulture, N.D. University of Agriculture & TEchnology, Kumarganj, Fazabad during 2005-06. The experiment consists of ten treatments including 0.5% $ZnSO_4$, 0.4% $CuSO_4$, 10 ppm NAA and 25 ppm GA, its combination and control (water spray). The average fruit length , breadth, weight, pulp weight and pulp: stone ratio significantly improved with combined spray of 0.5% $ZnSO_4$ + 10 ppm NAA + 25 ppm GA3 . However, non-significant differences were observed with respect to stone weight of fruits. Maximum fruit

retention and Juice content was recorded with spray of 0.5% $ZnSO_4$ + 0.4% $CuSO_4$ + 10 ppm NAA as compared to control with the minimum fibre content (1.15%) was recorded with foliar spray of same chemicals.

Gupta and Kaur (2007) assessed the growth regulators viz. eight , NAA and GA were sprayed at different stages of fruit development to prevent the pre harvest fruit drop in pulp cv. Satluj Purple. Singh spray of ethrel (50 and 100 ppm) was given during fourth week of March and first and second week of April. NAA (10 and 20 ppm) was sprayed twice during second and fourth week of April and GA (50 and 100 ppm) once during first week of March . Ethrel (100 ppm) applied during fourth week of March was the most effective treatment to reduce the pre-harvest drop followed by NAA (10 ppm) . The fruit retention, yield , fruit weight and total soluble solids were significantly higher with ethrel (100 ppm) applied during fourth week of March. The acid content was significantly lesser with ethrel (100 ppm) applied during fourth week of March during the both experimental years. Nitrogen content in leaves and shoots was maximum with ethrel (100 ppm) applied during second week at April. The highest carbohydrate content in leaves and shoots was recorded in NAA (10 ppm),.

Singh (2008) carried out experiment at the JNKVV College of Agriculture, Rewa (M.P.) and found that spraying of GA3 (50 ppm) at marble stage or 20 days before harvest enhanced the specific gravity and pulp percentage and improved the organoleptic rating with consumers acceptability i.e. appearance, flavour, taste and texture of

Sunderja mango fruits during 12 days after storage. GA3 has also encouraged the TSS and total sugar up to 8 days, thereafter it was slightly decreased up to 12 days and discouraged the acidity of fruits. Carbandazim (200ppm) followed by GA3 (50 ppm) increased the marketable fruit percentage by reducing the spoilage of fruits during 12 days after harvest $CaCl_2$ (1%) and 2, 4-D (20 ppm) enhanced the fruit weight, while physiological weight loss decreased due to 2, 4-D. Thus , the findings allude that GA3 , carbandazim and 2,4-D have got significant role in maintaining and augmenting the physico-chemical properties of mango fruits up to 12 days of their storage.

CHAPTER – III

MATERIAL AND METHODS

The present investigation entitled "**Effect of post harvest treatment on shelf- life and quality of Langra mango"** was conducted during the year of 2012-13. The details of materials and methods adopted for the present investigation are being presented in this chapter.

Experimental site

The experiment was carried out in mango orchard of Fruit Research Station, Kuthulia, College of Agriculture, Rewa (M.P.) and chemical analysis of the fruits was done in the laboratory of the Department of Soil Science, College of Agriculture, Rewa (M.P.).

Climate and weather conditions

Rewa is situated in the North- Eastern part of Madhya Pradesh at latitude $24^0$31N, $81^0$15E and altitude of 365.7 meters above the mean sea level. Rewa enjoys the sub-tropical climate hot and dry summer and cold winter are the main characteristics features of this region. Sometimes the winter temperature touches the freezing point. In general , the highest and lowest temperature go above 43.3^0C and below 5^0C respectively. The annual rainfall varies from 900 mm to 1150 mm which is received mainly from July to September and sometimes winter rain are also occurred.

The meteorological data such as maximum and minimum temperature, sunshine hours, rainfall, number of rainy days, maximum and minimum percentage of humidity and wind velocity are presented in Table 1 and graphically presented in Fig 1.

Experimental technique

The experiment was conducted on six thousand fruit collected from the mango cv. Langra at a part at Fruit Research Station, Rewa were selected for the study during year 2012, twenty fruit considering as a treatment was replicated 3 times in a Randomized block design. The chemical are MH- (1000 ppm), GA3 (250 ppm) Hot water (50 $\pm^{0}$C) . Potassium permanganate, silver nitrate (1%) wax emulsion coating (6%), Neem oil perforated polythene and control.

Table 3.1 Metrological data (December 2011 to June – 2012)

Month	Temperature ^{0}C		Humidity		Rainfall mm	No. of rainy days
	Max.	Min.	Max.	Min.		
Dec.	24.18	3.30	79.85	55.92	0.00	00
Jan.	22.79	7.10	76.78	23.56	1.15	2
Feb	23.71	7.46	71.28	34.24	0.00	00
March	30.07	14.02	73.99	43.85	0.00	00
April	37.30	17.90	80.56	33.70	0.00	00
May	40.42	21.10	78.17	34.53	0.00	00
June	43.43	25.21	74.71	33.17	0.00	00

Source : Meteorological observatory, Kuthulia Farm, College of Agriculture, Rewa (M.P.)

Experimental details

Details of treatment

1.	MH- 1000 ppm	-T_1
2.	GA_3 250 ppm	- T_2
3.	Hot water (50 $\pm$ 2^0C) 5 minut	-T_3
4.	Potassium permanganate (6%)	-T_4
5.	Silver nitrate - 40 ppm	- T_5
6.	Calcium nitrate (1%)	- T_6
7.	Wax emulsion coating (6%)	- T_7
8.	Neem Oil pure	- T_8
9.	Perforated polythene 300 gauge	- T_9
10	Control	- T_{10}

Location	:	FRS, Kuthulia, Rewa
Design	:	Randomized block
No. of replications	:	3
Treatments	:	10
No. of fruit tree per treatment:		20
Total number of fruit trees	:	600
Variety	:	Langra

Observation to be recorded:

Flowering and fruit set :

1. Average fruit weight (gm)
2. Fruit length (cm)
3. Fruit girth
4. Pulp weight (gm)
5. Stone weight (gm)

6. Specific gravity
7. Volume of fruit (m)
8. Spoilage
9. T.S.S. (Brix)
10. Acidity (%)
11. Total sugar (%)
12. Sugar acidity ratio
13. Peel thickness (cm)
14. Pulp thickness (cm)
15. Pulp colour
16. Loss in weight (%)
17. Shelf-life (days) in room temperature
18. Shelf-life of fruit two days interval

Harvesting: The harvesting of fruits was done after reaching the maturity. It was decided by maturity index. After harvesting, fruits were stored at ambient conditions.

Observations: In this investigation, observations were recorded on the two parameters viz., physical and chemical at an interval of 4 days for a total period of 12 days during storage.

(A) Physical parameters

1. Average weight of fruit: Twenty randomly selected mature fruits were weighed and weight was recorded in grams

2. Length of fruit: The length of the twenty randomly selected fruits was measured and the average length per fruit was measured with the help by variety cub par in cm.

3. Girth of fruit : The width of twenty randomly selected fruits was measured in cm and average girth per fruit was recorded.

4. Pulp weight (%) : Twenty ripped fruit are randomly selected and removed the pulp from ripe fruits and weighted with the triple of electric balance the pulp weight was measured in percentage.

5. Stone percentage: The weight of the stone of the same fruit was measured and the percentage was calculated as per the formula given below:

$$\text{Stone percentage} = \frac{\text{Weight of stone}}{\text{Weight of fruits}} \times 100$$

6. Specific gravity: The weight of randomly selected fruits was recorded. These fruits were placed in a glass jar full of water and the volume of replaced water was measured with the help of measuring cylinder. The specific gravity was calculated as per the formula given below.

$$\text{Stone percentage} = \frac{\text{Total weight of fruit}}{\text{Total volume of replaced water by fruits}} \times 100$$

7. Volume of fruit (ml): The twenty fruits were randomly selected and the fruit place in a glass Jar full of water and the volume of replaced water was measured with the help of measuring of cultivar

8. Spoilage: The spoilage fruit in different were counted after 5,10 and 15 day of storage and percent of the spoilage fruit was recorded as per formula given below.

$$\text{Spoilage (\%)} = \frac{\text{No. of spoilage fruit at 5,10 and 15 day}}{\text{Total no. of fruit stored}} \times 100$$

9. Peel thickness (cm) : The peel thickness of the 20 fruit randomly fruit was measured and the average peel thickness per fruit was measured in (cm).

10. Pulp thickness (cm) : The pulp thickness of the twenty randomly selected fruit was measured with the help by verneer calipers and the average pulp thickness per fruit was measured in cm.

11. Pulp colour : The pulp colour of observed by the help of mansipal colour chart at 5 , 10 and 15 day of stored fruit in.

12. Physiological weight loss of fruits (%) : The weight of mango fruits was taken just after harvesting as well as 5,10 and 15 days after storage and percentage of physiological weight loss of fruit was calculated with the help of following formula.

$$\text{Physiological weight loss (\%)} = \frac{W1-W2}{W1} \times 100$$

Where: W1= Initial weight of fruit

W2= weight after 5, 10 and 15 days of storage

13. Self life (day) in room temperature: Twenty mature fruits of each treatment were kept in room temperature for repining without deterioration of fruit was counted

14. Shelf life of fruit after two day interval: Visual observation of fruit were observed at two days

Chemical parameters

For determination of chemical constitution of fruits, homogeneous sample of fruit juice was prepared after crushing the pulp of randomly selected fruits from each treatment which used for the estimation of following parameters as per the methods of A.O.A.C. (1990)

1. Total soluble solids (TSS)

TSS of juice was measured by hand refractometer of 0-32^{0}Brix range. Few drops of juice were put on prism with the help of clean class rods. The cover of refractometer was folded lightly and looked through eye piece with projection inlet facing towards light, the point where the boundary line of shaded area interacts with the un shaded area of the scales was noted. The specimen chamber was cleaned with muslin cloths after every use. The reading were taken at room temperature,

Acidity

Acidity was estimated by simple acid – alkaline titration method as described in A.O.A.C. (1990) Twenty milliliter of fruit juice solution was taken by pipette in a 100 ml flask to which distilled water was added to make the volume up to 100 ml and shaked 25 ml of diluted fruit juice was taken by pipette and transferred into a 250 ml beaker to which 3 drops of phenolphthalein indicator was added and titrated

with N/10 NaOH solution till the pink end point reached. End point was recorded and the percentage acidity in term of citric acid was calculated by the following formula

Total acidity (%) = 0.128 x titration value

Method for estimation of sugars in fruit juice

(a) Preparation of Fehling's solution "A"

Weighed (34.639 g) copper sulphate (A.R.) crystal were transferred to a clean and dry 500 ml volumetric flask to which 0.5 ml of concentrated sulphuric acid and some distilled water were added and shaked well to dissolve and added distilled water to make the volume up to mark (500 ml)

(b) Preparation of Fehling's solution "B"

Dissolved 173.0 g of pure sodium potassium tratarate (Rochelle salt) and 50 g of sodium hydroxide in distilled water and made the volume 500 ml in volumetric flask by adding distilled water.

(c) Glucose solution (0.5%)

2.5 g of glucose (A.R. Anhydrous) was dissolved in distilled water and made the volume to 500 ml by adding distilled water

Total sugar

For the estimation of total sugars, 20 ml of fruit juice solution was taken in a beaker and 5 ml of concentrated HCI was added and then the solution was boiled on water bath for five minutes for the hydrolysis to convert the non-reducing sugar into reducing sugar. After cooling the excess of acid was neutralized by sodium carbonate solution. The solution was transferred in a 100 ml volumetric flask and volume was made up to mark by adding distilled water. This solution was taken in a burette and titrated with the Fehling's solution

“A” and “B” similar as was done in reducing sugar. The total sugar in percentage was calculated with the help of following formula

$$\text{Total sugar (\%)} = \frac{1.25}{\text{Burette reading}} \times 100$$

Sugar acidity ratio-

After measure the sugar and acidity of the fruit the sugar and acidity ratio measure by total divided by total acidity the sugar acidity ratio calculate by the given formula

$$\text{Sugar acidity ratio} = \frac{\text{Total sugar}}{\text{Total acidity}}$$

Statistical analysis

Analysis of different treatment combinations was carried out to know the degree of variation amongst all the treatment combinations. The data were statistically analyzed by the method given by Panse and Sukhatme (1963). the analysis of variance has been given in appendix and the skeleton of ANOVA for Randomized Block Design is presented in Table

Table - The skeleton of analysis of variance

Source of variation	d.f.	S.S.	M.S.S.	F. calculated	"t" tabulated at
					5%
Replication	2				
Treatment (t)	9				3.0
Error	18				
Total	29				

To test the significance

difference among the treatment means, the following formula were used for calculating the critical difference

S.Em $\pm$ and C.D. for treatment, Chemicals & PGR's (t)

$$\text{S.Em} \pm = \sqrt{\frac{\text{Error variance}}{\text{Replication (3)}}}$$

$$\text{C.D.} = \text{SEm} \pm \sqrt{2} \times \text{'t' (5\% for error d.f.)}$$

Presentation of data

All the interpretation of the data in the chapter IV (Experimental Findings) are based on "F" test and C.D. (Critical difference). The results of various parameters as influenced by different treatment combinations have been presented in table and illustrated by bar diagrams as well as graphical curves.

CHAPTER - IV

RESULTS

The result of experiment entitled "**Effect of post harvest treatment on shelf- life and quality of Langra mango"** is presented in his chapter. The experiment carried out at field the fruit research station, Kuthulia, College Agriculture, Rewa during the year 2011-12 the experiment data has been summarized and the result are presented with statistical analysis and supported by relevant diagram wherever necessary.

4.1. Average fruit weight (cm)

The data presented in Table 4.1 and fig. 4.1 indicates the various treatments significantly influenced the average fruit weight. The maximum fruit weight was recorded in MH (1000 ppm) (232.90 gm) which is at par with wax emulsion cooling (229.97 gm) and the minimum fruit weight was founded in performed polythene (212.03 gm) which is at par with neem oil (219.17 cm).

4.2 Average fruit length (cm):

The data presented in Table 4.1 and fig.4.2 indicates that the various treatments significantly influenced the average fruit length. The maximum fruit length was recorded in wax emulsion coating (6%) (10.79 cm) which is at par with MH (1000 ppm) (10.47 cm) and the minimum fruit length was founded in silver nitrate (40 ppm) (9.55 cm) which is at par with control (9.73 cm).

4.3 Average fruit girth (cm):

The data presented in Table 4.1and fig. 4.3 indicated that the various treatments significantly influenced the average fruit girth. The maximum fruit girth was recorded in hot water (50 $\pm$ 2^0c) (7.13 cm) with is at par with MH (1000 ppm) and calcium nitrate (1%) (7.07 cm) and the minimum fruit girth was founded in control (6.59 cm) weight is at par with perforated polythene (6.71 cm).

4.4 Pulp weight (%):

The data presented in Table 4.1 and fig no 4.4 indicate that the various treatment significantly influenced the pulp weight. The maximum pulp weight was recorded in MH (1000ppm) (72.66%) which is at par with GA (250 ppm) (72.42 %) and the minimum pulp weight was founded in control (71.69%) which is at par with hot water (50 $\pm$ 2^0c) (71.94).

4.5 Stone weight (%):

The data presented in Table 4.1 and fig. no 4.5 indicate that the various treatment significantly influenced the stone weight. The maximum stone weight was recorded in hot water (50 $\pm$ 2^0c) (12.68%). which is at par with wax emulsion coating (6%) (12.17%) and the minimum stone weight was founded in perforated polythene (11.89%) which is at par with hot water (11.98).

Table 4.1 Effect of various treatments on average fruit weight (gm), average ,Fruit length (cm), average fruit girth (cm), pulp weight (%) and Stone weight (%).

S.No.	Treatment	Average fruit weight (gm)	Average fruit length (cm)	Average fruit girth (cm)	Pulp weight (%)	Stone weight (%)
1	MH (1000 ppm)	232.90	10.47	7.07	72.66	12.03
2	GA (250 ppm)	228.10	10.36	6.90	72.42	12.16
3	Hot water (50 ± 2 ^{0}C) 5 minut	221.73	10.04	7.13	71.94	12.68
4	Potassium permanganate (6%)	223.83	10.20	6.74	72.21	12.06
5	Silver nitrate (40 ppm)	222.30	9.55	6.77	72.06	11.98
6	Calcium nitrate (1%)	224.93	10.13	7.07	72.20	12.08
7	Wax emulsion coating (6%)	229.97	10.79	6.91	72.26	12.17
8	Neem oil pure	219.17	9.97	6.82	72.04	12.02
9	Perforated polythene 300 gauge	221.63	9.87	6.71	71.95	11.89
10	Control	212.03	9.73	6.59	71.69	11.93
	S.Em ±	**1.3427**	**0.198**	**0.121**	**0.124**	**0.173**
	C.D at 5%	**3.896**	**0.576**	**0.352**	**0.360**	**0.503**

4.6 Specific gravity:

The data presented in Table 4.3 and fig no 4.6 indicate that the various treatment significantly influenced the specific gravity. The maximum specific gravity was recorded MH (1000 ppm) (1.09) which is at par with perforated polythene (1.08) and the minimum specific gravity was founded in control (1.01) which is at par with wax emulsion coating (6%) & Neem oil (1.02).

4.7 Volume of fruit:

The data presented in table 4.2 and fig no. 4.7 indicate that the various treatment significantly influenced the volume of fruit . The maximum volume of fruit was recorded in MH (1000 ppm) (213.53). which is at par with GA (250 ppm) (208.13) and the minimum volume of fruit was founded in control (187.30) which is at par with perforated polythene (197.97).

4.8 Peel thickness (cm):

The data presented in table 4.2 and fig no.4.8 indicate that the various treatments significantly influenced the peel thickness of fruit. The maximum peel thickness was recorded in MH (1000 ppm) & GA3 (250ppm) (0.20 cm). Which is at par with potassium permanganate (0.19 cm)? The minimum peel thickness was founded in calcium nitrate (1%) & neem 0.1 (0.17 cm). This is at par with wax emulsion coating (6%) (0.18cm).

4.9 Pulp thickness (cm) :

The data presented in table 4.2 and fig no.4.9 indicate that the various treatment significantly influenced the pulp thickness. The maximum pulp thickness was recorded in potassium permanganate (1.43 cm) which is at par with MH (1000 ppm) & GA (250 ppm) (1.41 cm) and the minimum pulp thickness was founded in wax emulsion coating (6%) (1.35cm) which is at par calcium nitrate (1%) (1.37 cm).

4.10. Pulp color:

The table 4.2 that indicate after 5 days of treatment of fruit by various treatment material no change in pulp color except in neem oil, perforated polythene, and control treated fruit. These show yellow color. After 10 days of storage all treated fruit was show yellow color except in control neem oil, and perforated polythene they show dark yellow color and after 15 days of storage all treated fruit with various treatment show dark yellow color except neem oil, perforated polythene and control these shown brownish yellow color.

4.2 Effect of various treatment on pulp color

S.No.	Treatment	Pulp color		
		5 days	10 days	15 days
1	MH (1000 ppm)	WY	Y	DY
2	GA (250 ppm)	WY	Y	DY
3	Hot water (50 ± 2 ^{0}C) 5 minut	WY	Y	DY
4	Potassium permanganate (6%)	WY	Y	DY
5	Silver nitrate (40 ppm)	WY	Y	DY
6	Calcium nitrate (1%)	WY	Y	DY
7	Wax emulsion coating (6%)	WY	Y	DY
8	Neem oil pure	Y	DY	BY
9	Perforated polythene 300 gauge	Y	DY	BY
10	Control	Y	DY	BY

WY = White Yellow, Y =Yellow , DY= Dark Yellow ,BY= Brownish Yellow

Table 4.3 Effect of various treatments on specific gravity, volume of fruit, peel thickness and pulp thickness.

S. No.	Treatment	Specific gravity	Volume of fruit	Peel thickness (cm)	Pulp thickness
1	MH (1000 ppm)	1.09	213.53	0.20	1.41
2	GA (250 ppm)	1.031.03	208.13	0.20	1.41
3	Hot water (50 ± 2 ^{0}C) 5 minut	1.03	198.70	0.18	1.41
4	Potassium permanganate (6%)	1.02	204.57	0.19	1.43
5	Silver nitrate (40 ppm)	1.03	199.57	0.18	1.39
6	Calcium nitrate (1%)	1.02	202.80	0.17	1.37
7	Wax emulsion coating (6%)	1.02	205.70	0.18	1.35
8	Neem oil pure	1.08	198.53	0.17	1.39
9	Perforated polythene 300 gauge	1.01	197.97	0.17	1.38
10	Control	0.022	187.30	0.17	1.38
	S.Em ±	**0.065**	**2.337**	**0.008**	**0.108**
	C.D at 5%		**6.781**	**0.024**	**0.031**

4.11 Physiological loss in weight (%):

It is evident from the data presented in table 4.4 and fig. 4.10 that there was a share increase in physiological weight loss of mango fruit treated however. The increase in physiological weight loss was found to be significantly loss in fruit with potassium permanganate (3.15, 6.18,and 9.33) which is at par with silver nitrate (40 ppm) (4.12, 8.24 and 12.36 %) at 5:10 and 15 day. Where the maximum physiological loss of weight was recorded in control (14.34, 28.63 and

43.02) which is at par with neem oil (11.51, 23.03 and 35.06) at 5, 10 and 15 days.

Table 4.4: Effect of various treatments on physiological loss in weight.

S. No.	Treatment	5 day	10 days	15 day
1	MH (1000 ppm)	6.05	12.09	18.17
2	GA (250 ppm)	7.52	14.68	22.35
3	Hot water (50 ± 2 ^{0}C) 5 minut	9.63	19.26	28.89
4	Potassium permanganate (6%)	3.15	6.18	9.33
5	Silver nitrate (40 ppm)	4.12	8.24	12.36
6	Calcium nitrate (1%)	8.61	17.23	25.84
7	Wax emulsion coating (6%)	5.42	10.83	16.32
8	Neem oil pure	11.51	23.03	35.06
9	Perforated polythene 300 gauge	10.61	21.16	31.83
10	Control	14.34	28.68	43.02
	S.Em ±	**0.083**	**0.216**	**0.362**
	C.D at 5%	**0.273**	**0.629**	**1.052**

4.12 Spoilage (%):

It is evident from the data presented in table 4.5 and fig. 4.11 that there was a share increase in spoilage of mango fruit treated.

However, the increase in spoilage was found to be significantly loss in fruit with potassium permanganate (0.00, 38.03 and 47.60) Which is at par with silver nitrate (40 ppm) (9.52, 42.80 and 57.10) at 5, 10 and 15 day where the maximum spoilage was recorded in control (75.39, 94.44 and 100.00) which is at par with neem oil (69.83, 89.68 and 94.44) at 5, 10 and 15 days.

Table 4.5 Effect of various treatment on Spoilage (day)

S. No.	Treatment	5 day	10 days	15 day
1	MH (1000 ppm)	24.60	65.87	69.83
2	GA (250 ppm)	34.92	69.83	74.60
3	Hot water (50 ± 2 ^{0}C) 5 minut	60.31	80.15	84.92
4	Potassium permanganate (6%)	0.00	38.03	47.60
5	Silver nitrate (40 ppm)	9.52	42.80	57.10
6	Calcium nitrate (1%)	45.23	75.39	80.15
7	Wax emulsion coating (6%)	14.28	52.38	61.90
8	Neem oil pure	69.83	89.68	94.44
9	Perforated polythene 300 gauge	65.07	84.92	89.68
10	Control	75.39	94.44	100.00
	S.Em ±	**2.713**	**4.907**	**3.7555**
	C.D at 5%	**7.874**	**14.240**	**10.899**

4.13 T.S.S. (^{o}Brix):

The data presented in table 4.6 and fig no 4.13 indicate that the various treatment significantly influenced the T.S.S.(19.51). Which is

at per with GA3 (250 ppm) (18.85) and the minimum T.S.S. was founded in control (17.58) which is at par with perforated polythene (17.73).

4.14 Acidity (%):

The data presented in table 4.6 and fig 4.12 mat show me various treatment significant effect on Acidity of fruit. The maximum acidity was recorded in potassium permanganate (0.44) which is at par with silver nitrate and neem oil 90.40 and 0.40%) and the minimum acidity was founded in hot water (0.35) which is at par with calcium nitrate (0.36).

4.15 Total sugar (%):

The data presented in table 4.6 and fig 4.14 that show the various treatment significant effects on total sugar of fruit the maximum sugar was recorded in perforated polythene (17.55) which is at par with control (17.45) and the minimum sugar was founded in the (17.11) which is at par with calcium nitrate (17.26).

4.16 Sugar Acidity ratio:

The data presented in table 4.6 and fig. 4.15 that show the various treatment significant effects on sugar acidity ratio was recorded in perforated polythene (48.60) which at par with hot water (48.43) and the minimum sugar acidity ration was founded in Neem oil (43.53) which is at par with calcium nitrate (45.59).

Table 4.6 Effect of various treatments on acidity (%), total sugar (%), T.S.S. and sugar acidity ratio.

S. No.	Treatment	Acidity (%)	Total sugar (%)	T.S.S.	Sugar acidity ratio
1	MH (1000 ppm)	0.38	17.11	18.64	46.12
2	GA (250 ppm)	0.37	17.32	18.85	48.13
3	Hot water (50 ± 2 ^{0}C) 5 minut	0.35	17.35	18.19	48.43
4	Potassium permanganate (6%)	0.44	17.35	19.51	48.31
5	Silver nitrate (40 ppm)	0.40	17.35	18.13	47.93
6	Calcium nitrate (1%)	0.36	17.26	18.38	45.59
7	Wax emulsion coating (6%)	0.39	17.31	18.55	45.99
8	Neem oil pure	0.40	17.35	18.08	43.53
9	Perforated polythene 300 gauge	0.37	17.35	17.73	48.60
10	Control	0.39	17.45	17.58	45.97
	S.Em ±	**0.026**	**0.0916**	**0.191**	**1.569**
	C.D at 5%	**0.055**	**0.266**	**0.553**	**4.553**

4.17 Self life

The data presented in the table 4.7 and fig 4.16 that indicate the various treatments significantly influenced the self life mango fruit in two day interval the maximum self life recorded in potassium per magnet. Silicate (85.97), (6.503), (47.57), (28.50) and (14.23) at a 4 days, 6 days , 8 days, 11 days and 15 days interval. Which is at par with silver nitrate (80.96), (64.63), (42.80) (28.50) and (9.47) and the minimum self of fruit was founded in control (61.87), (42.80), (19.0)

(4.73) at 4, 6, 8, 11 and 15 days interval which is at par (71.40), (52.35), (28.50) (4.73) at 4, 6, 8, 11.

Table 4.7 Effect of various treatments on Self life in (day) room temperature after ripening

S. No.	Treatment	Self life in (day) room temperature after ripening
1	MH (1000 ppm)	10.65
2	GA (250 ppm)	9.27
3	Hot water (50 ± 2 ^{0}C) 5 minut	8.33
4	Potassium permanganate (6%)	13.87
5	Silver nitrate (40 ppm)	13.78
6	Calcium nitrate (1%)	9.13
7	Wax emulsion coating (6%)	10.80
8	Neem oil pure	13.17
9	Perforated polythene 300 gauge	6.93
10	Control	5.97
	S.Em ±	5.65
	C.D at 5%	NS

4.18. Self life in room temperature after ripening fruits:

The data printed in the table 4.8 and fig.4.17 that indicate the various treatment significantly influence the self life in room temperature after ripening fruit the maximum self life in room temperature was recorded potassium permanganate (26.10) which is at par silver nitrate (13.87) and the minimum self life in room temp.

Founded in the control (5.97) at which is at par pert rated polythene (6.93).

Table 4.8 Effect of various treatments on self life at 2 day interval.

S. No.	Treatment	2 day	4 day	6 day	8 day	11 day	15 day
1	MH (1000 ppm)	100	80.90	52.33	33.27	18.97	4.73
2	GA (250 ppm)	100	71.40	52.43	38.03	42.73	9.42
3	Hot water (50 ± 2 ^{0}C) 5 minut	100	66.63	52.33	28.50	4.73	0.0
4	Potassium permanganate (6%)	100	85.95	65.03	47.57	28.50	14.23
5	Silver nitrate (40 ppm)	100	80.96	64.63	42.80	28.50	9.47
6	Calcium nitrate (1%)	100	80.70	66.63	42.80	23.73	0.0
7	Wax emulsion coating (6%)	100	76.17	57.10	42.80	28.50	9.43
8	Neem oil pure	100	71.40	52.33	28.50	4.73	0.0
9	Perforated polythene 300 gauge	100	76.17	57.10	42.80	28.50	4.73
10	Control	100	61.87	42.80	19.0	4.73	0.0
	S.Em ±		4.058	4.379	5.882	6.088	3.867
	C.D at 5%		11.777	12.708	17.070	17.669	11.223

CHAPTER - V

DISCUSSION

The result of present experiment in title ‘‘Effect of post harvest treatment on shelf life in quality of Langra mango’’ have been discussed critically in the life of the recant review of literature. The whole finding have been discussed in the appropriate headings physical parameter of fruit, chemical quality of fruit and storage life of fruit.

1. Average fruit weight:

The result of effect of fruit weight indicates that various treatment significantly. The maximum fruit weight was recorded in MH (1000ppm) (232.90 g) while minimum fruit weight was found in control (212.03 g). These finding are confounded with Sandhu and Subhadra bandhu (1992) observed that pre-harvest spray of GA_3, Vipul and Bavistin at a different consents ration result at increase in fruit weight.

1. Length of the fruit:

The result of effect of length of fruit show that various treatment significantly. The maximum fruit length was recorded in wax emulsion coating (6%) (10.97 cm) while minimum length of fruit was found in silver nitrate (40ppm) (9.55cm).

2. Girth of the fruit:

The result on the girth of the fruit reveal that various treatment significantly. The maximum girth of the fruit was notes in

calcium nitrate (1%) (7.07 cm) while minimum girth of the fruit was recorded in control (96.59 cm).

Pulp weight (%):

The result of effect of the pulp weight show that various treatment significantly. The maximum pulp weight was notes in MH (100ppm) (72.66%) while minimum pulp weight was recorded in control (71.69%).

Stone weight:

The result present on stone weight indicates that various treatment significantly. The maximum stone weight was showed wax emulsion coating (6. %) (12.17%) while minimum stone weight was noted in perforated polythene (11.89%).

3. Specific gravity:

The result on the specific gravity of the fruit indicates that various treatment significantly. The maximum specific gravity of the fruit was noted in MH (1000ppm) (1.09) while minimum specific gravity of the fruit was found in control (1.01).

7. Volume of fruit:

The result presented on volume of fruit reveal that various treatment significantly the maximum volume of fruit was noted MH (1000ppm) (218.53). While minimum volume of fruit was found in control (187.30 ml).

8. Peel thickness

The result present on peel thickness indicated that various treatment Non-significant. The maximum peel thickness was should GA3 (250 ppm) (0.20 cm). While minimum peel thickness was noted in Neem oil (0.17 cm) and per forted polythene (0.17 cm).

9. Pulp thickness

The result present on pulp thickness indicates that various treatment significantly. The maximum pulp thickness was show potassium permanganate (1.43 cm).While minimum pulp thickness were recorded in wax emulsion coating (6%) (1.35 cm).

10. Pulp color.

All treated fruit by various treatments more effective in pulp color that show dark yellow color after 15 days except neem oil, perforated polythene and control that shown brownish yellow color after 15 days of storage.

11. T.S.S.

The result of effect T.S.S. shows that various treatment significantly. The maximum T.S.S. was showed potassium permanganate (19.51^0Brix). While minimum T.S.S was noted in control (17.58^0Brix). These findings are conformed to Gautam et al (2003) noted the T.S.S. of mango fruit treated with potassium permanganate (17.31).

12. Shelf life in (day) room temperature after ripening

The result of effect of shelf life in (day) room temperature after ripening indicates that various treatment significantly. The maximum shelf life in (day) room temperature was recorded in potassium permanganate (13.87 day) . While minimum shelf life in (day) room temperature was found in control. The findings are conformed to Singh et al. (1993) noted All ca treatments delayed ripening and improved fruit quality during storage. Control fruit could be stored for only 6 days.

13. Loss in weight (%):

The result of effect of loss in weight shows that various treatment significantly. The maximum loss of weight was noted in control (14.34, 28.68 and 43.02%). While minimum loss in weight was recorded in potassium permanganate (3.15, 6.18 and 9.33%) at 5, 10 and 15 day interval.These findings are conformed with Narayan et al (1996).

14. Spoilage (%)

The result on spoilage of the fruit indicates that various treatment significantly. The maximum spoilage of the fruit was noted in control (75.39, 94.44 and 100.00%). While minimum spoilage of the fruit was found in potassium permanganate (0.00, 38.03 and 47.60%) at 5, 10 and 10 day interval. These findings are confirmed with Gautam et al. (2003). The potassium per manganese silica gel treatment and ZECC storage was most effective in delaying in spoilage of the fruit.

15. Shelf life at 2 day interval

The result of effect of shelf life at 2 day interval shows that various treatment significantly. The maximum shelf life at 2 day interval of the fruit was noted in potassium permanganate (100, 85.95, 65.03, 47.57, 28.50 and 14.23). While minimum shelf life at 2 day interval of the fruit was recorded in control (100, 61.87, 42.80, 19.0, 4.73 and 00.00) at 2,4,6,8,11 and 15 day interval. These finding are confirmed with Narayan et al (1996) was noted most effective in extending self life increase it to 8, 12 and 23 days in different treatment.

16. Acidity (%)

The result presents on acidity show that various treatment significantly. The maximum acidity was found in potassium permanganate (0.44%). While minimum acidity was recorded in hot water (50 $\pm$ 2^0c) (0.35%).

17. Total sugar (%)

The result of effect of total sugar shows that various treatment significantly. The maximum total sugar was showed in control (17.45 %) while minimum total sugar was noted in MH (1000 ppm) (17.11%). These findings are conformed with Singh et al. (2008)

18. Sugar acidity ratio

The result present on sugar acidity ratio indicate non-significant. The maximum sugar acidity was noted in perforated polythene (48.60). While minimum sugar acidity ratio was recoded in Neem oil (43.53).

CHAPTER - VI

SUMMARY

The present investigation entitled " **Effect of post harvest treatment on shelf-life and quality of Langra mango**" was carried and at the field experiment area department of Horticulture College of Agriculture, Rewa (M.P.) during spring cropping season 2011-12 find out the suitable post harvest treatment to enhance the shelf life and quality of Langra mango.

The present experiment was laid out in randomized block design comparing 10 treatments with these three replication.

The observation were recorded on average fruit weight (g), fruit length (cm), fruit girth (cm), Pulp weight (%), stone weight (%), specific gravity, volume of fruit (ml.), peel thickness (cm), pulp thickness (cm), T.S.S. (Brix), physiological loss in weight (%) spoilage (%) , Acidity (%), Total sugar (%), sugar acidity ratio, shelf life (day) in room temperature , shelf life of fruit two day interval.

The result obtained during me investigation are summarized as below

1. Effect of average fruit weight indicate that various treatment were significantly. Maximum average fruit weight was recorded in MH (1000 ppm) (232.90). Whereas the minimum average fruit weight found in control (212.03g)
2. Effect of fruit length indicates that various treatment significantly. Maximum fruit lengths were recorded in wax

emulsion coating (6.11) (70.79 cm) whereas, the minimum fruit length was found in silver nitrate (40ppm) (9.55 cm).

3. Effect of fruit girth indicates that various treatment significantly. Maximum fruit girth were recorded in MH (1000 ppm) (7.07 cm) and calcium nitrate (1%) (7.07 cm) whereas the minimum fruit length was found in control (6.59 cm).

4. Effect of pulp weight show that various treatment significantly maximum pulp weight were recorded in MH (1000 ppm) (72.66%) whereas the minimum pulp weight of fruit was found in control (71.69%)

5. Effect of stone weight indicates that various treatment significantly. Maximum fruit stone weight were record in wax emulsion coating (6%) (12.17%) whereas the minimum stone weight was found in perforated polythene (11.89)

6. Effect of specific gravity shows that various treatment significantly. Maximum specific gravity were recorded in MH (1000 ppm) (1.09) whereas minimum specific gravity was found in control (1.01).

7. Effect of volume of fruit indicate that various treatment significantly maximum volume of fruit were recorded in MH (1000 ppm) (213.53 ml) whereas the minimum volume of fruit was found in control (187.30 ml)

8. Effect of peel thickness reveal that various treatment non-significantly maximum peel thickness were recorded in GA_3 (250ppm) (0.2cm) and MH (1000 ppm) (0.20 cm) and minimum

peel thickness fruit was found in calcium nitrate (1%) (0.17 cm) and Neem oil (0.17 cm)

9. Effect of pulp thickness show various treatment significantly. Maximum pulp thickness were recorded in potassium permanganate (1.43 cm) whereas minimum pulp thickness was found in wax emulsion coating (6%) (1.35 cm).

10. Effect of Loss in weight indicates that various treatment significantly. Maximum loss was recorded in control (14.34, 28.68 and 43.02) whereas the minimum loss was found in potassium permanganate (3.15, 6.18 and 9.33) at 5,10 and 15 day interval .

11. Effect of spoilage indicate that various treatment significantly maximum spoilage wee recorded in control (75.39, 94.44 and 100%) and minimum spoilage was found in potassium permanganate (0.00, 38.03 and 47.60%) at 5, 10 and 15 days.

12. Effect of T.S.S. show that various treatments significantly maximum TSS were recorded in potassium permanganate (19.51^0Bix) and minimum T.S.S. was found in control (17.58^0Bix).

13. Effect of shelf life in (day) room temperature after ripening show that various treatment significantly. Maximum shelf life in (day) room temperature after ripening were recorded in potassium permanganate (13.87 day) and minimum shelf life in

(day) room temperature after ripening was found in control (5.97 day).

14. Effect of shelf life at 2 day interval show that various treatment significantly maximum shelf life at 2 day interval were recorded in potassium permanganate (100, 85.95, 65.03, 47.57, 28.50 and 14.23) and minimum shelf life at 2 day interval was found in control (100, 61.87, 42.80, 19.0, 4.73, and 00.00) at 2,4,6,8,11 and 15 day interval.

15. Effect of acidity reveal that various treatment significantly maximum acidity were recorded in potassium permanganate (0.44%) and minimum acidity was found in hot water (50 $\pm$ 2^0c) (0.35%)

16. Effect of total sugar show that the various treatment significantly, maximum total sugar were recorded in control (17.45%) and minimum total sugar was found in MH (1000 ppm) (17.11%)

17. Effect of sugar acidity ratio indicates that various treatment non-significantly maximum sugar acidity ratios were recorded in perforated polythene (48.60) and minimum sugar acidity ratio was found in Neem oil (43.53).

Conclusion

- The least performing treatment regarding to the most effective on shelf life of mango fruit was fruit are treated with potassium permanganate

- The maximum shelf life stored fruit at room temperature was recoded in the fruit are treated with potassium permanganate. Compared to other treatment the ripe fruit

Suggestion for further work

The experiment should be repeated to confirm the finding of investigation.

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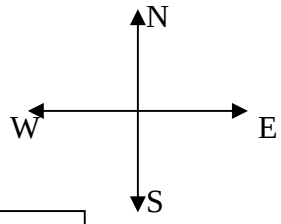

LAYOUT PLAN

R_1	R_2	R_3
T_1R_1	$T_{10}R_2$	T_2R_3
T_2R_1	T_9R_2	T_1R_3
T_3R_1	T_8R_2	T_5R_3
T_4R_1	T_7R_2	T_6R_3
T_5R_1	T_6R_2	T_4R_3
T_6R_1	T_5R_2	T_3R_3
T_7R_1	T_4R_2	T_8R_3
T_8R_1	T_3R_2	T_9R_3
T_9R_1	T_2R_2	$T_{10}R_3$
$T_{10}R_1$	T_1R_2	T_7R_3

Fig. no.2 Experimental layout plan

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APPENDIX- I
Average fruit weight

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	142.502	71.251	9.880369	2.96
Treatments	9	934.6653	103.8517	14.40111*	2.25
ERROR	18	129.8047	7.21137		
Total	29				

***Significant at 5%**

APPENDIX- II
Avarage fruit length

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	1.29218	0.64609	4.091354	2.96
Treatments	9	3.591403	0.399045	2.526945*	2.25
ERROR	18	2.842487	0.157916		
Total	29				

***Significant at 5%**

APPENDIX- III

Avarage fruit Girth

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	0.551647	0.275823	4.686357	2.96
Treatments	9	0.84668	0.094076	1.598384*	2.25
ERROR	18	1.05942	0.058857		
Total	29				

***Significant at 5%**

APPENDIX- IV

Pulp weight (%)

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	1.94078	0.97039	15.72821	2.96
Treatments	9	2.000547	0.222283	3.602793*	2.25
ERROR	18	1.110553	0.061697		
Total	29				

***Significant at 5%**

APPENDIX- V

Stone weight (%)

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	1.148667	0.574333	4.775499	2.96
Treatments	9	1.34483	0.149426	1.242452*	2.25
ERROR	18	2.1648	0.120267		
Total	29				

***Significant at 5%**

APPENDIX- VI

Specific gravity

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	0.004827	0.002413	1.18559	2.96
Treatments	9	0.02	0.002222	1.091703*	2.25
ERROR	18	0.03664	0.002036		
Total	29				

***Significant at 5%**

APPENDIX- VII

Volume of fruit

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	818.474	409.237	18.73195	2.96
Treatments	9	1355.148	150.572	6.892113*	2.25
ERROR	18	393.246	21.847		
Total	29				

***Significant at 5%**

APPENDIX- VIII

Peel thicknes (cm)

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	0.005174	0.002587	9.405262	2.96
Treatments	9	0.003901	0.000433	1.575818*	2.25
ERROR	18	0.004951	0.000275		
Total	29				

***Significant at 5%**

APPENDIX- IX

Pulp thickness

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	0.00554	0.00277	5.847537	2.96
Treatments	9	0.015003	0.001667	3.519156*	2.25
ERROR	18	0.008527	0.000474		
Total	29				

***Significant at 5%**

APPENDIX- X

Loss in weight (%) 5 day

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	0.949487	0.474743	16.91998	2.96
Treatments	9	334.6668	37.1852	1325.29*	2.25
ERROR	18	0.505047	0.028058		
Total	29				

***Significant at 5%**

APPENDIX- XI

Loss in weight (%) 10 day

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	2.548987	1.274493	6.768925	2.96
Treatments	9	1347.418	149.7131	795.1368*	2.25
ERROR	18	3.389147	0.188286		
Total	29				

***Significant at 5%**

APPENDIX- XII

Loss in weight (%) 15 day

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	3.782847	1.891423	3.592591	2.96
Treatments	9	3054.263	339.3625	644.5891*	2.25
ERROR	18	9.47662	0.526479		
Total	29				

***Significant at 5%**

APPENDIX- XIII

Spoilage (%) in 5 day

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	115.9568	57.97839	1.968344	2.96
Treatments	9	19993.95	2221.55	75.42075*	2.25
ERROR	18	530.1976	29.45542		
Total	29				

***Significant at 5%**

APPENDIX- XIV

Spoilage (%) in 10 day

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	391.9102	195.9551	2.03443	2.96
Treatments	9	10273.72	1141.524	11.85145*	2.25
ERROR	18	1733.749	96.31938		
Total	29				

***Significant at 5%**

APPENDIX- XV

Spoilage (%) in 15 day

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	754.7683	377.3841	6.687697	2.96
Treatments	9	7808.453	867.6059	15.37501*	2.25
ERROR	18	1015.733	56.42961		
Total	29				

***Significant at 5%**

APPENDIX- XVI

T.S.S.

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	3.534927	1.767463	12.06274	2.96
Treatments	9	8.536533	0.948504	6.47343*	2.25
ERROR	18	2.637407	0.146523		
Total	29				

***Significant at 5%**

APPENDIX- XVII

Acidity (%)

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	0.009447	0.004723	3.284316	2.96
Treatments	9	0.016813	0.001868	1.298996*	2.25
ERROR	18	0.025887	0.001438		
Total	29				

***Significant at 5%**

APPENDIX- XVIII

Total Sugar (%)

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	0.082047	0.041023	1.219817	2.96
Treatments	9	0.349187	0.038799	1.153662*	2.25
ERROR	18	0.605353	0.033631		
Total	29				

***Significant at 5%**

APPENDIX- XIX

Sugar Acidity Ratio

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	7.766287	3.883143	0.394338	2.96
Treatments	9	75.50428	8.389365	0.85195*	2.25
ERROR	18	177.2504	9.847247		
Total	29				

***Significant at 5%**

APPENDIX- XX

Self life (4day)

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	177.2056	88.6028	1.344877	2.96
Treatments	9	1472.786	163.6429	2.48389*	2.25
ERROR	18	1185.87	65.88169		
Total	29				

***Significant at 5%**

APPENDIX- XXI

Self life (6day)

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	363.9047	181.9523	2.37181	2.96
Treatments	9	1605.632	178.4036	2.32555*	2.25
ERROR	18	1380.862	76.71456		
Total	29				

***Significant at 5%**

APPENDIX- XXII

Self life (8day)

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	94.95267	47.47633	0.343003	2.96
Treatments	9	2184.519	242.7243	1.753614*	2.25
ERROR	18	2491.447	138.4137		
Total	29				

***Significant at 5%**

APPENDIX- XXIII

Self life (11day)

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	40.04867	20.02433	0.135027	2.96
Treatments	9	4504.31	500.4789	3.374809*	2.25
ERROR	18	2669.371	148.2984		
Total	29				

***Significant at 5%**

APPENDIX- XXIV

Self life (15day)

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	14.90067	7.450333	0.124525	2.96
Treatments	9	746.9337	82.99263	1.387142*	2.25
ERROR	18	1076.939	59.82996		
Total	29				

***Significant at 5%**

APPENDIX- XXV

Self life in (day) Room temperature

ANOVA TABLE					
SOURCE	**DF**	**SS**	**MS**	**F CAL**	f tab
REP	2	0.114	0.057	0.167119	2.96
Treatments	9	195.2787	21.69763	63.61559*	2.25
ERROR	18	6.139333	0.341074		
Total	29				

***Significant at 5%**

"Effect of post harvest treatment on shelf-life and quality of Langra mango"

THESIS ABSTRACT

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Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur

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In

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HORTICULTURE (FRUIT SCIENCE)

By

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ABSTRACT

Mango (*Mangifera indica* L.) is the member of anacardiaceae family and it is one of the most commercial fruits of India. India ranks first in mango production. In India it occupies an area of 2, 35,607 thousand hectare is 42 percent area devoted to fruit crops and with a total production of 1,35,570 thousand million tonnes. In which Madhya Pradesh, occupies an area 16.3 thousand hectare and production is 146.6 thousand metric tonnes (Data base 2009-2010). Rewa region of Madhya Pradesh has great potentiality for mango cultivation; it occupies an area of 7202 hectare.

Mango is good source of nutrients. Mango pulp is the most important which is utilized for human consumption. Fruit pulp predominates in water, carbohydrates, fiber organic acids, fats, minerals, pigments, tannin, and vitamin. The ripe fruits pulp contains about 11.8 percent carbohydrates, 4800 IU of vitamin A and 13 mg/100 mg ascorbic acid. The pulp is a rich source of ß carotene; sucrose, glucose and fructose constitute the bulk of carbohydrates and most of the soluble solids in mango pulp.

The fore said objectives can be achieved to some extent by use of growth regulator, wax emulsion coating, perforated polythene, use of fungicide, calcium treatment and silver nitrate and hot water treatment to enhancing the self life and quality of Langra mango. Keeping this in view, the present study was under taken at the Fruit Research Station, Kuthulia, College of Agriculture, Rewa during the year 2011 with the following objectives.

1. To enhance the shelf-life through checking the rate of microbial infection and protection membranes' by used of post harvest treatment.
2. To find out the post harvest causes by use of growth regulator, wax emulsion, perforated polythene, use of fungicide enhancing the self-life and quality of Langra mango.
3. To enhance the markebility of fruit for longer period without adverse affecting the quality.

SUMMARY

The present investigation entitled " **Effect of post harvest treatment on shelf-life and quality of Langra mango**" was carried and at the field experiment area department of Horticulture College of Agriculture, Rewa (M.P.) during spring cropping season 2011-12 find out the suitable post harvest treatment to enhance the shelf life and quality of Langra mango.

The present experiment was laid out in randomized block design comparing 10 treatments with these three replication.

The observation were recorded on average fruit weight (g), fruit length (cm), fruit girth (cm), Pulp weight (%), stone weight (%), specific gravity, volume of fruit (ml.), peel thickness (cm), pulp thickness (cm), T.S.S. (Brix), physiological loss in weight (%) spoilage (%) , Acidity (%), Total sugar (%), sugar acidity ratio, shelf life (day) in room temperature , shelf life of fruit two day interval.

The result obtained during me investigation are summarized as below

1. Effect of average fruit weight indicate that various treatment were significantly. Maximum average fruit weight was recorded in MH (1000 ppm) (232.90). Whereas the minimum average fruit weight found in control (212.03g)
2. Effect of fruit length indicates that various treatment significantly. Maximum fruit length wee recorded in wax emulsion coating (6.11) (70.79 cm) whereas, the minimum fruit length was found in silver nitrate (40ppm) (9.55 cm).
3. Effect of fruit girth indicates that various treatment significantly. Maximum fruit girth wee recorded in MH (1000 ppm) (7.07 cm) and calcium nitrate (1%) (7.07 cm) whereas the minimum fruit length was found in control (6.59 cm).
4. Effect of pulp weight show that various treatment significantly maximum pulp weight were recorded in MH (1000 ppm) (72.66%) whereas the minimum pulp weight of fruit was found in control (71.69%)
5. Effect of stone weight indicates that various treatment significantly. Maximum fruit stone weight were record in wax emulsion coating (6%) (12.17%) whereas the minimum stone weight was found in perforated polythene (11.89)
6. Effect of specific gravity shows that various treatment significantly. Maximum specific gravity were recorded in MH (1000 ppm) (1.09) whereas minimum specific gravity was found in control (1.01).
7. Effect of volume of fruit indicate that various treatment significantly maximum volume of fruit were recorded in MH (1000

ppm) (213.53 ml) whereas the minimum volume of fruit was found in control (187.30 ml)

8. Effect of peel thickness reveal that various treatment non-significantly maximum peel thickness were recorded in GA_3 (250ppm) (0.2cm) and MH (1000 ppm) (0.20 cm) and minimum peel thickness fruit was found in calcium nitrate (1%) (0.17 cm) and Neem oil (0.17 cm)

9. Effect of pulp thickness show various treatment significantly. Maximum pulp thickness were recorded in potassium permanganate (1.43 cm) whereas minimum pulp thickness was found in wax emulsion coating (6%) (1.35 cm).

10. Effect of Loss in weight indicates that various treatment significantly. Maximum loss was recorded in control (14.34, 28.68 and 43.02) whereas the minimum loss was found in potassium permanganate (3.15, 6.18 and 9.33) at 5,10 and 15 day interval .

11. Effect of spoilage indicate that various treatment significantly maximum spoilage wee recorded in control (75.39, 94.44 and 100%) and minimum spoilage was found in potassium permanganate (0.00, 38.03 and 47.60%) at 5, 10 and 15 days.

12. Effect of T.S.S. show that various treatments significantly maximum TSS wee recorded in potassium permanganate (19.51^0Bix) and minimum T.S.S. was found in control (17.58^0Bix).

13. Effect of shelf life in (day) room temperature after ripening show that various treatment significantly. Maximum shelf life in (day) room temperature after ripening wee recorded in potassium

permanganate (13.87 day) and minimum shelf life in (day) room temperature after ripening was found in control (5.97 day).

14. Effect of shelf life at 2 day interval show that various treatment significantly maximum shelf life at 2 day interval were recorded in potassium permanganate (100, 85.95, 65.03, 47.57, 28.50 and 14.23) and minimum shelf life at 2 day interval was found in control (100, 61.87, 42.80, 19.0, 4.73, and 00.00) at 2,4,6,8,11 and 15 day interval.

15. Effect of acidity reveal that various treatment significantly maximum acidity wee recorded in potassium permanganate (0.44%) and minimum acidity was found in hot water (50 $\pm$ 2^0c) (0.35%)

16. Effect of total sugar show that the various treatment significantly, maximum total sugar were recorded in control (17.45%) and minimum total sugar was found in MH (1000 ppm) (17.11%)

17. Effect of sugar acidity ratio indicates that various treatment non-significantly maximum sugar acidity ratios were recorded in perforated polythene (48.60) and minimum sugar acidity ratio was found in Neem oil (43.53).

Conclusion

- The least performing treatment regarding to the most effective on shelf life of mango fruit was fruit are treated with potassium permanganate

- The maximum shelf life stored fruit at room temperature was recoded in the fruit are treated with potassium permanganate. Compared to other treatment the ripe fruit should be kept in storage for many days.
- When fruit are treated with potassium permanganate and the minimum spoilage and physiological losses weight was also recorded in the fruit are treated with potassium permanganate the method of treatment of fruit with potassium permanganate show severity over all other treatment in respect to the shelf life and fruit quality parameter

VITA

The author of this thesis ***Mr. Dinesh Kumar Ahirwar***, **S/o Shri Hariram Ahirwar** was born on 21 June, 1985 at Rehli, District- Sagar (M.P.). He passed his High School certificate examination in the year 2002 from Govt.Agriculture H.S. School, Rehli, Sagar with 53.23% marks and Higher Secondary certificate examination in the year 2004 from Govt.Agriculture H.S. School, Rehli, Sagar with 68.65 % marks.

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