

# Research Status on Fruit Research and Future Strategy under Nepal Agriculture Research Council

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## Abstract

The total area, productive area, production and productivity of fruits in 2020 are 119025 ha, 1249764mt and 10.50 mt/ha respectively. Even though area and production of fruits have doubled during last 15 years (2001 to 2015) but fruit productivity is not increased. In the horticulture sector, vegetable is in better position than that of fruits. Because of no external support, perennial in nature, long time need for research results and unclear policy, fruit research is lack behind. In this context, NARC has made an effort to streamline six thematic areas of fruit research such as varietal improvement, production technologies, plant protection, post-harvest management, germplasm collection and its evaluation and propagation methods. In recent years, some promising technologies have been developed in some fruit crops; mango, citrus, papaya, banana, pomegranate, apple, walnut, kiwi fruit, litchi, Dragon fruit, and mecademia nut. Different pre and post-harvest management technologies are developed in mandarin, acid lime, papaya, kiwi, banana and pineapple and Pomegranate butter fly management in Pomogranate, anthracnose disease management in citrus and delay ripening technique in banana fruit and internal browning management in pineapple fruit. Among varietal development research, four varieties of kiwifruit, two in banana, four in litchi, two in citrus has been registered in National Seed Board. Beside this, three in mango (Malbhog, Dashehari, Amrapali), two in citrus (Washington navel and, Banskharka local proposal submitted for registration in National Seed Board. Grafting time and success rate in walnut showed better performance in Chaitra 1-22 with in-situ than bench grafting situation. Beside this, research on new emerging fruit crops like avocado, berries being studied and will get some output within few years. As lot of works to be done in fruit research within different constraints situation, research priority areas should be listed and research works should be done phase by phase according to the priority fixed.

**Keywords:** Fruit crops, germplasm, pre and post-harvest management, promising, registration

## Introduction

The total cultivated area is around 3.09 million hectares, of which around 3.88% is covered by fruit crops. The contribution of the horticulture

sector amounts to 39% of Agriculture GDP, of which almost half is constituted by fruits. Owing to its greatly varied geographical and climatic conditions, altitude ranging from 70m (Kechana Kalan in Jhapa) to 8848 masl (Mt. Everest),

The total area, productive area, production and productivity of fruits in the Fiscal Year 2020 are 119025 ha, 1249764 mt and 10.50 mt/ha respectively (MoALD, 2021). The data showed that area and production of fruits have doubled

during last 15 years (2000/01 to 2015/16) but fruit productivity is around 10 MT/ha only (MoALD, 2019). However, the contribution of fruit to AGDP is 5 percent.

**Table 1:** Area, Production and Productivity of Fruits in Nepal

Year	Area (ha)	Production (mt)	Productivity (mt/ha)
2002/03	80426	51016	10.17
2006/07	94901	57595	9.99
2010/11	117932	79184	10.03
2014/15	150387	110802	8.96
2016/17	162660	110502	9.22
2017/18	111744	1086931	9.72
2018/19	120023	1177640	9.82
2019/20	119025	1249764	10.00

Source: MOALD, 2021

### **Fruit research stations under NARC**

NARC have few research stations for conducting fruit research and assigned different research stations according to agro-ecological zone. Horticulture Research Station, Rajikot, Jumla is situated at high hills and do research on deciduous fruits; apple, walnut. DoAR Lumle, Kaski and DoAR Pakhribus, Dhankutta is situated at high hills and do research on deciduous fruits and sub temperate fruits. HRS Dailekh, HRS Malepatan, Kaski, NHRC Khumaltar, Lalitpur is situated at mid-hills and do research on sub temperate fruit crops. National Citrus Research Program situated at mid hill and looks after all citrus crop research and technology development. Likewise, DoAR Nepalgunj, DoAR Parwanipur Bara, and DoAR Tarahara is situated at Terai and do research on tropical fruit crops; Mango, Litchi, Banana whereas DoAR Surkhet, DoAR Doti are situated at river bed area and do research on tropical fruit crops.

Nepal accommodates wider biodiversity, and this applies to the growing of diverse biotypes

of fruit species as well. There are 45 species belonging to 37 genera of wild edible fruits (Kaini 2004, 2012; Kaini et al. 2016). Seasonal fruits harvested from the forests can be seen in many local markets even today. Southern Terai regions are suitable for cultivation of tropical fruits while mid-hills and high-hills towards north are suitable for sub-tropical to warm and cold temperate fruit and nut species (Atreya and Manandhar, 2016). People are willing to consume more fruits to be healthy. Due to seasonal aspect and quality concern, import of fresh as well as processed products is being high.

Fruit research in NARC in general is struggling to deliver the technological need of clients despite vegetable is in better position than that of fruits. Because of no external support from international organization, perennial in nature, long time need for research results and unclear policy, fruit research except citrus is in extreme dearth. In this context, NARC has made an effort to streamline six thematic areas of fruit research such as varietal improvement, production technologies, plant protection, post-harvest management, germplasm collection and its

evaluation and propagation methods. National Horticulture Research Center (NHRC) under NARC has been working with goal of contributing horticulture development through the use of modern technologies. NHRC coordinates at national level with various research stations for fruit research, germplasm conservation, quality seed and saplings production and variety maintenance. It establishes linkage with national and international horticultural research organizations and provides technical support to horticulture researchers. It has taken strategies; collection and utilization of genetic resources from local and exotic sources, varietal improvement through conventional and biotechnical tools and productivity enhancement through proper utilization of natural resources and spaces, production enhancement during lean-season through variety diversification, modification of cultural practices and protected cultivation, protecting consumers' health by safe food production, post-harvest loss reduction, high quality source seed and mother stock production, public-private partnership in horticulture research, expand international collaboration, improvement of technical capacity

of researchers and develop necessary research infrastructure and national network.

In recent years, some promising technologies have been developed in some fruit crops; mango, citrus, papaya, banana, pomegranate, apple, walnut, kiwi fruit, litchi, pineapple, and mecademia nut are given here. Different pre and post-harvest management technologies were developed in citrus, papaya, kiwi, banana and pineapple and anthracnose disease management in citrus, and delay ripening technique in banana fruit and internal browning management in pineapple fruit. These technologies were tried to present in this paper.

### ***Glimpse of Recent Fruit Research***

#### ***1. Germplasm collection, evaluation and varietal release and registration***

##### ***1.1 Varietal Evaluation in Kiwifruit***

Six cultivars; Hayward long, Hayward round, Bruno, Allison, Red kiwi and Golden kiwi were kept in varietal evaluation study at NHRC Khumaltar and among them, Hayward, Allison, Abbot and Bruno has been registered for mid and high-hills region.

**Table 2:** Comparison of Registered Kiwifruit varieties

<b>Varieties/ Characters</b>	<b>Hayward</b>	<b>Abbott</b>	<b>Allison</b>	<b>Bruno</b>
Suitable Elevation	1400- 2500 masl	1100-2100 masl	1100-2100 masl	1100-2100 masl
Flowering	Late	Early among green fleshed	Mid (after abbott)	Mid (after Allison)
Average Fruit	8.4±22.1	48.5±22.1	48.5±7.1	51.7±9
Yield	100-140 kg/vine	60-80 Kg/vine	80-100 Kg/vine	80-90 Kg/vine
Storage life	Long	Medium	Medium	Medium
Adaptability	High/Superior in flavor and farmers were much more attracted	Medium	Medium	Popular to rootstock

**Hayward** : Recommended for mid to high-hills, late maturing cultivar with 100-140 kg production per plant.

**Abbott** : Recommended for mid-hills, early maturing variety with 60-80 kg production per plant.

**Allison** : Recommended for mid-hills, medium season maturing variety with 80-100 kg production per plant.

**Bruno** : Recommended for mid-hills, medium season maturing variety with 80-90 kg/vine.

### 1.2 Varietal Development in Banana

In Nepal local varieties (Malbhog) and Dwarf Cavendish are being grown up to 1630 m from sea level. These two varieties are resistant to drought (Thapa and Karmaccharya, 1990). With long efforts, three varieties of Banana (G9, William hybrid and Malbhog) have been registered by Horticulture Research Division in collaboration with Fruit Development Program and SQCC.

**William hybrid** : This variety attain 6-8 ft plant height and come under reproductive stage after producing 12-13 leaves. Days from flowering to harvest takes 2.5 months and gives average 140 fingers per plant. Fruits are attractive yellowish green color, average fruit per plant is 15-25 kg and average yield 40-50 tons per hectare.

**Malbhog** : This variety attain 2.5 meter plant height. Days from flowering to harvest takes 3 months and gives average 90-150 fingers per plant. Fruits are light yellow color at ripening, average fruit yield per plant is 12-15 kg and average yield 15-20 tons per hectare.

**Grand Nain -G9** : This variety attain 2-2.5 meter plant height. Days to 50% flowering takes 12 months after transplanting. Days to maturity from flowering to harvest is 2.5 months and gives average 175-225 fingers per plant. Fruits are attractive yellowish green color at ripening, average fruit yield per plant is 30 kg and average yield 50-55 tons per hectare. One

bunch contains 10-12 hands per plant.

### 1.3 Evaluation of Pomegranate Cultivars

A multi-location evaluation trial on pomegranate germplasms has been conducted at Khumaltar, Nuwakot, Nepalgunj, Surkhet, Dailekh and Malepatan. Ten germplasms of pomegranate were evaluated for their vegetative and pomological characteristics at HRD Khumaltar. The preliminary result revealed that HRDPOM02 was the dwarf genotype and HRDPOM01 was grown upright. The highest fruit yield was produced in HRDPOM05 (4 kg per plant) and HRDPOM011 (3.5 kg per plant), HRDPOM004 (4.9 kg/plant) and HRDPOM011(9.12 kg/plant) at 5 years after plantation. With respect to fruit size, HRDPOM02 produced the smallest (115.7g) and HRDPOM05 the largest size (250.3 g). It was found that HRDPOM05 produced the soft, small seed. The sweetest aril (14.4% brix) was found in HRDPOM004M followed by HRDPOM010 (13.6) and HRDPOM005 (13.5) and HRDPOM004 (12.4). The vitamin C (88.98 mg/100g) was found in HRDPOM001 followed by HRDPOM011 (84.74 mg/100g) and HRDPOM004M (81.88 mg/100g) and HRDPOM010 (80.51 mg/100g). One of the best cultivar will be submitted proposal for registration in this fiscal year.

### 1.4 Varietal Evaluation of different germplasm of Guava

Different six varieties of Guava fruit were collected and planted on FY 2075/76. They are Apple Guava, Pear shaped, Bangalore, KG-1, Ilam selection and Bari. Maximum fruit length was found in Pear Shaped (71.1 mm) and the minimum was found in Bari (50.2 mm). The highest individual fruit weight was observed in Apple Guava (229.5 gm) and the lowest fruit weight was in Ilam Selection (59.4 gm). Analysis of variance for different characters showed a high degree of variation among the genotypes. Among them, Apple Guava and KG-1 were found superior according to fruit size, taste,

sweetness, and so on under mid-hill conditions while pear shaped was found tolerant to frost.

### 1.5 Varietal Development in Walnut

In recent years, seventy-three different germplasms of walnut were collected from Mustang, Jumla and Dolpa districts and its phonological characters were identified (Lumle, 2020). Among them thirteen superior genotypes were selected where ten genotypes were preserved at Lumle through asexual propagation method.

### 1.6 Varietal Development in Citrus

In 2019, one acid lime variety, "Tehrathum local" was registered for mid-hills. It has roundish fruit, peel soft and thin, slightly yellowish while ripening. Average fruit weight 35-50 g where acid percentage 7-10 (17 ml/fruit). Flowering time Falgun and fruit ripens in Kartik to Poush after 3-4 years after planting. In the same year, Khoku local mandarine was registered for eastern mid-hills (1000-1600 m) where plant height attains 2 meter in 9-13 years old plant. Fifty percent flowering time in Falgun-Chaitra, fruit ripens in Paush-Magh. Fruit has 11 segments with 15-16 seeds per fruit, bears fruits 16-24 t/ha.

#### Proposed citrus varieties for registration

**Washington navel** : One of the sweet orange variety, found excellent in terms of quality fruit yield and to be suitable for off-season production. Fruit is seed less, suitable for low

altitude and matures in Kartik-Mangsir.

**Valentialate** : This genotype is in the process of being proposed for varietal release. Beside this, Valentia late is also seed less promising variety, fruit matures in Chaitra month.

**Okitsuwase** : This cultivar is early maturing mandarin orange which ripens from Bhadra and recommended for 800-1400 m. It bears fruit containing TSS 8%, TA 0.9 % having Average fruit weight 120 gm, fruit diameter 57 mm and juice 64 ml per fruit. This genotype has been proposed for varietal release.

**Banskharka Local** : This cultivar bears fruits with average fruit weight 101 gm with diameter 58 mm, and peel thickness 2.17 mm. Fruit contains 10 segments with 38.2 percent juice, TSS 12%, TA 1.1%. Fruits ripen in Mangsir-Poush with productivity 29.18 ton/ha has been proposed for varietal registration.

### 1.7 Varietal Development in spur type of Apple

Germplasm evaluation and selection on Canadian and French spur type of apple cultivars are being on process at HRS Jumla, Rajikot, where some cultivars showing good performance. Result on varietal study showed three cultivars; Bright & early, Star Krimson Delicious and Star spur gold has been showing superior performance are proposed for registration.

**Table 3.** Yield and fruit characteristics of spur type of apple varieties at Jumla

S.N.	Cultivars	Av. Fruit weight (g)	Juice wt. (g)	Juice %	Juice amount/ fruit (ml.)	Brix (%)	TA (%)	Starch index (0-6)	Productivity (mt/ha)
1	Bright and Early	140	109	77.3	107	9	0.29	2.5	8.66
2	Star Krimson Delicious	155	130	70.3	128	9	0.33	2	10.27
3	Spark spur gold	148	123	72.8	121	11	0.54	2.5	11.29

### 1.8 Varietal Development in Mango

Three mango cultivars for terai; Maldah, Dashari and Amrapali have been proposed for varietal registration. Maldah is early season variety

having 280-300 gm fruit size and medium size plant whereas Dashehari is mid-season variety having 170-175 gm fruit size and medium size plant. But, Amrapali is late season variety having 205-215 gm fruit size and dwarf plant (Table 4).

**Table 4.** Comparison of Proposed Mango varieties for Registration

Varieties/characters	Maldah	Dashehari	Amrapali
Origin	West Bengal India	Lucknow India	Delhi India
Cultivated in Nepal	More than 300 years	More than 300 years	More than 30 years
Flowering characteristics			
Maturity	Early season variety	Mid-season variety	Late season variety
Fruit Characters			
Average Fruitweight	280-300 gm	170-175 gm	205-215 gm
TSS (Brix)	17-19	20-22	18-22
TA (%)	0.3-0.6	0.15-0.18	0.1-0.4
Distinctness			
Plant height	Medium	Medium	Dwarf
Gestation period	Longest (4 years of planting)	Medium (3 years of planting)	Shortest (2 years of planting)

### 1.9 Varietal Development in Litchi

Litchi cultivars; Shahi, Muzaffarpur, Rose scented, late seedless, Early seedless and Kalkattia have been registered.

**Shahi** : Early season and regular bearing habit variety have medium to large sized attractive fruit which has high total soluble solid content

(19-22 oBrix). It is high yielding (140-150 kg per tree and less damage by natural pest like birds.

**Muzaffarpur** : Mid-season and regular bearing habit variety have large sized attractive fruit which has high total soluble solid content (19-22 o Brix). It is high yielding (80-100 kg per tree and less prone to cracking and sunburn.

**Table 5.** Comparison of registered Litchi varieties

Character	Shahi	Muzaffarpur	Kalkattia	Rose Scented	Late Seedless	Early Seedless
Maturity	Early	Medium	Late	Mid	late	Early
TSS (°Brix)	19-22	20	18.7	21.7	19.5	19.5
Size	Medium to large	Large size	Large	Medium-large	Large sized	Medium
Yield (kg)	140-150	80-100	80-100	80-90	80-100	50-60
Preference	Less damaged by birds	Less prone to cracking	Heavy bearer	Pleasant aroma	Small seed/ large flesh	Regular bearer



**Fig. 1.** Registered varieties of Litchi

**Kalkattia** : Late season and regular bearing habit variety have medium to large sized attractive fruit which has high total soluble solid content (19-22 oBrix). It is small size tree high yielding (80-100 kg per tree) with heavy bearing.

**Late seedless** : Late season have large sized fruit with small seed It is high yielding (80-100 kg per tree) and high fruit recovery percent.

**Rosescented** : Medium season bearing habit variety have medium to large sized fruit with pleasant aroma. It has 80-90 kg per tree yield.

*1.10 Varietal Evaluation on Dragon fruit*

Six genotypes of dragon fruit; HRDDRA001, HRDDRA002, HRDDRA003, HRDDRA004, and , are under evaluation at NHRC, Khumaltar, DoAR Tarahara, DoAR Nepalgunj, and DoAR Doti. Beside this, the four genotypes; HRDDRA001, HRDDRA002, HRDDRA003 and HRDDRA004 have been under evaluation at farmer's field of Trisuli, Melamchi, Nawalparasi and Myagdi.

*2. Post-harvest Loss Management*

Different pre and post-harvest management technologies are developed in mandarin, sweet orange, acid lime, papaya, kiwi, banana and pineapple.

*2.1 Development of appropriate postharvest handling technologies in papaya*

Different five maturity stages (MS1-mature green, MS2-green with yellow stripe, MS3-

more green than yellow, MS4-more yellow than green, MS5-yellow with green traces, MS6-full yellow) of papaya were determined. MS2 stage fruits were wrapped with different wrapping materials (Brown paper, Newspaper, Fibre Bag and Control) and kept in collapsible crates and transported to NHRC, Khumaltar from Hetauda (90 Km). The results showed that highest percentage of bruised fruits was recorded in non-wrapped fruits (70 %) as compared to wrapped fruit (5%). Similarly, the shelf life of fruits harvested at MS2 was recorded the highest (12 days) as compared to MS4 (6 days) under ambient conditions. Highest damage (100%) and highest transportation weight loss was recorded in fruits without wrapping materials. Minimum damage loss (5%) was with newspaper print wrapping and 70% damage loss was on control.

*2.2 Development of appropriate postharvest handling technologies in banana*

Evaluation of different types of bunch bagging to reduce the infestation of scarring beetle and improve the visual and post-harvest quality of banana var. William Hybrid was carried out in farmer's field in Pithuwa, Chitwan. The effect of covers (White polyethylene bag, Green polyethylene bag and Insect Exclusion Net bag) on the fruit quality parameter during storage was observed at room condition with 24.8±0.55°C temperature and 70±4.9% relative humidity. The banana bunch covered with white plastic

bag showed higher shelf life (15 days) and minimum spoilage loss (0.2%) with optimum acceptable quality (freshness, TSS and TA) till 15 days of storage among other treatment under observation. However, fruit firmness (0.29 kg/cm<sup>2</sup>) and color development was optimum in Green bagging.

### *2.3 Evaluation of skin coating and packaging to extend postharvest life of acid lime under storage condition*

#### *Treatments combinations*

Factor A: Storage condition: 2 (ambient and coolbot)

Factor B: Coating: 4 (mustard oil, sesame oil, castor oil, coconut oil, parafin wax, MAP (25 micron LDPE) and control)

Among the treatments; MAP (25 micron LDPE) was the best at ambient and cool bot storage condition. Sunkagati fruits could be kept upto 90 days in ambient storage and 110 days in cool bot condition with uniform color development and good appealing and marketing characters with longer shelf life during storage.

### *2.4 Evaluation of different postharvest treatment on pineapple to prolong the shelf life under ambient condition*

In recent years there is a problem on internal browning in pineapple flesh and cannot be stored for a longer duration thus to cope up with this problem an experiment was carried out treated with salicylic acid and Aloe-Vera gel under coolbot and ambient condition. The two variety Giant and Kewat physiological matured stage were harvested at cool hour from the farmer's field and packed in a crate and brought back to Laboratory of NHRC, Khumaltar on the same date of harvest from Karkare, Sindhuli. The fruits were kept at shade condition for pre cooling and the experiment were set up on the next day. The fruits were done by dipping in different salicylic acid (3 and 5 mM/L) concentration and coated with Aloe Vera gel with brush (readymade 250

gm gel on a whole trail), and control condition. Fruits stored from 18thMansir to 28 Poush and remained marketable up to 14 days at ambient condition and 35 days in cool bot condition.

Result showed that Aloe-Vera coated fruits stored in coolbot storage has less physiological weight loss (1.06%) with higher TSS (12.53°Brix) followed by fruits treated with dipping in salicylic acid (3mM) under coolbot condition showed low TA (0.35%), higher vitamin C Content (38.1 mg/100gm) than ambient storage condition. Aloe-Vera coated fruit was found effective in pineapple fruit in terms of quality perspective i.e. delayed internal browning index and also extended shelf life from 16 days (ambient storage) to 40 days under coolbot condition.

#### *Assessment of storability of different Kiwi varieties*

Four Kiwi fruit varieties; Allison, Bruno, Hayward and Abbott fruits were collected from the Surya Kiwi Farm, Phaskot, Kavre and Fruits were sealed in 16 perforated 25µLDPE (MAP) stored at ambient and under coolbot storage. Initial weight, TSS (°Brix), TA (%), Vit.C, color value (L\*, a\*, b\*) and freshness (1-5) was recorded just after harvesting of fruits and at 20 days' interval during the storage period. Result showed that maximum weight loss was observed in Abbott (13.6%) and minimum was in Hayward (9.21%) at 140 days of coolbot storage. Total Soluble solid (TSS) were increased and Titrable Acidity (%) and vitamin C content (mg/100 gm) were decreased with the advancement of storage period. The color value (L\*, a\* and b\*) were also analyzed and the modified atmosphere packaging function as a retardant color development. General storability of Kiwi fruits was 42 Days at ambient condition (13.5 °C and 55% RH) and 140 Days under coolbot condition (5-7°C and 95-97% RH). Thus, the research revealed that modified atmosphere packaging in combination of coolbot storage was more effective for post-harvest storage of kiwifruits.



### 3. Crop Management

#### 3.1 Effect of plant growth regulators and micronutrients to control fruit drop in macadamia nut

Macadamia trees usually produce numerous flowers borne on axillary racemes and a mature tree can produce more than 10,000 racemes each consisting of 100 – 300 flowers. However less than 10% of flowers can be successfully fertilized and set young fruit in 2 weeks after anthesis, and 80% of the premature fruits are abscised in the following 8 weeks. This is presumably caused by a shortage of carbohydrates for rapid fruit development. The excessive fruit drop is a common problem in the macadamia orchards across the production regions of western mid hills in Nepal. Thus, this

phenomenon has posed a major challenge to the cultivation and expansion of Macadamia Nut Orchard.

Macadamia Nut fruit drop trends in the interval of 15 days (both treatments and counting of fruits) spraying and counting from 1stJestha 2076 to 22ndBhadra 2076 (9 times; 4 times spray and 9 times counting). According to the graph, the fruit drop slow down with the application of 6 BAP (200 ppm) + Micronutrient (2.5 ml/lit. water) with sticker (2.5 ml/lit water) than the other treatments. Finally, fruit no was highest in the record date than the other treatments recorded. Application of cytokinin @ 200 PPM and micronutrient @ 2.5 ml/litre water help to decrease the fruit drop in macadamia nut (HRS, 2019).

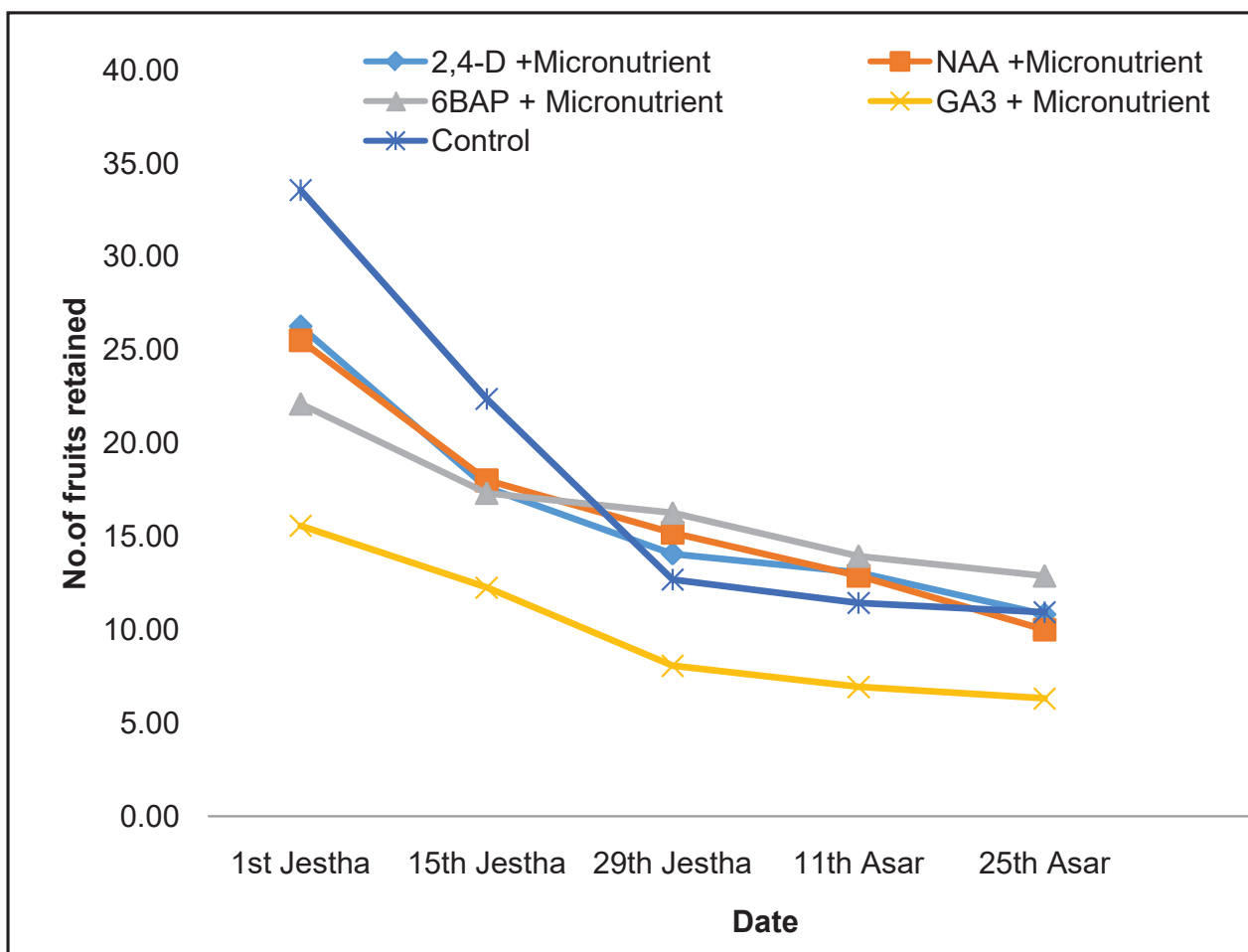


Fig. 2. Effect of different chemical spray and number of fruits retained on Mecedamia nut

#### 4. Plant Propagation

##### 4.1 Plant propagation method on *Mecademia nut*

Plant propagation method study conducted on different types of grafting at Malepatan, Kaski where inarching technique has been found higher success but not satisfied. Hence, study is

continued to find out appropriate time of grafting rather than monsoon season (HRS, 2020).

##### 4.2 Plant propagation time on Walnut

Grafting time and success rate in walnut showed better performance in Chaitra 1-22 with in-situ than bench grafting situation. Further research work is going on to understand the suitability of the rootstock.

**Table 6.** Study on appropriate time of grafting on walnut at Jumla

S.N.	Date	Variety	Grafting method	Success (%)
1	2076 Chaitra 1 <sup>st</sup>	Paine	Tongue grafting	48
2	2076 Chaitra 8 <sup>st</sup>	Paine	Tongue grafting	44
3	2076 Chaitra 15 <sup>th</sup>	Paine	Tongue grafting	46
4	2076 Chaitra 22 <sup>nd</sup>	Paine	Tongue grafting	46
5	2076 Chaitra 1 <sup>st</sup>	Hartley	Tongue grafting	66
6	2076 Chaitra 8 <sup>th</sup>	Hartley	Tongue grafting	80
7	2076 Chaitra 15 <sup>th</sup>	Hartley	Tongue grafting	95
8	2076 Chaitra 22 <sup>nd</sup>	Hartley	Tongue grafting	80

#### 5. Insect Pest Management

##### 5.1 Identification of Effective Pomegranate Butterfly and Fruit Drop Management Practices

Fruit dropping is a major problem in Pomegranate growers. Hence, a study conducted at NHRC Khumaltar, just after fruit set by bagging of individual fruits with Taiwani butter paper bags, bagging of individual fruits with mustard oil soaked newspapers, Netting of pomegranate tree with insect proof nylon net, Spraying of Margo Neem insecticide (Azadirachtin 0.15% EC) @ 3 ml/litre of water for five times at 15 days' interval and compared with farmer's practice (control). Result showed that covering of individual fruits with Taiwani butter paper bag after fruit set may be a viable option to minimize pomegranate butterfly infestation and to improve the quality of fruits

#### 6. Disease management

##### 6.1 Citrus canker disease management

Study conducted at National Citrus Research

Program, Dhankutta showed that 1% Bordo mixture should be sprayed in Falgun, Jestha and Aswin months before appearance of disease. If disease symptoms appeared, Kasugmycin 1.5 ml per litre water should be sprayed from Falgun to end of monsoon season at 12-15 days' interval. As this disease is more appeared on leaf minor infested plants, these insects should be controlled through Metacid or Dimethoate spraying at the rate of 1 ml per litre water.

##### 6.2 Soil drench with hexconazole and chloropyriphos controlled the foot rot/wilt in betal nut

Soil drench with Titan (hexconazole)@ 1ml/L + Super killer (chloropyriphos) 1ml/L controlled the foot rot/wilt in betal nut.

#### Future strategies

- Land exploration of National Horticulture Research Center at Khumaltar .
- Productivity enhancement through elite type collection and proper utilization of

natural resources and spaces

- Collaboration and linkage establishment with Agriculture Knowledge Centre and Government farm for out-reach research program.
- Improvement of technical capacity of researchers
- Postharvest technologies developed and Local language manual will be published and distributed in the different commodities; Citrus, Pineapple, Papaya, Banana, Strawberry
- A total of 9 fruit varieties will be registered and or released in the coming FY. It will be Pomegranate (2 varieties), Guava (2), Pear (1), Dragon fruit (2), Pineapple (2).

## Conclusion

Even though area and production of fruits have doubled during last 15 years (2001 to 2015) but fruit productivity is not increased. In the horticulture sector, vegetable is in better position than that of fruits. Because of no external support, perennial in nature, long time need for research results and unclear policy, fruit research is lack behind. In this context, NARC has made an effort to streamline six thematic areas of fruit research such as varietal improvement, production technologies, plant protection, post-harvest management, germplasm collection and its evaluation and propagation methods. In recent years, some promising technologies have been developed in some fruit crops; mango, citrus, papaya, banana, pomegranate, apple, walnut, kiwi fruit, litchi, pineapple, dragon fruit, and mecademia nut. Different pre and post-harvest management technologies are developed in mandarin, acid lime, papaya, kiwi, banana and pineapple and Pomogranate butterfly management in Pomogranate, anthracnose disease management in citrus and delay ripening technique in banana fruit and internal browning management in pineapple

fruit. Among varietal development research, four varieties of kiwifruit, two in banana, four in litchi, two in citrus has been registered in National Seed Board. Beside this, three in mango (Malbhog, Dashehari, Amrapali), two in citrus (Washington navel and, Banskharka local proposal submitted for registration in National Seed Board. Grafting time and success rate in walnut showed better performance in Chaitra 1-22 with in-situ than bench grafting situation. Beside this, research on new emerging fruit crops like avocado, berries being studied and will get some output within few years. As lot of works to be done in fruit research within different constraints situation, research priority areas should be listed and research works should be done phase by phase according to the priority fixed.

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