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Fungicide free management of papaya Anthracnose (*Colletotrichum gloeosporioides* Penz.) disease using combined bio-rationales and bee wax in Organic Agriculture

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INTRODUCTION

Papaya (*Carica papaya* L.): Caricaceae

- **High nutritive fruit-Tropical sub tropical**
- **Specially rich in Vitamin C(511.2mg/100g)**
- **Ripen fruit contain high levels of carbohydrate (42.28%/100g, 15.5%/100g) low level of fat Leaves, unripen ,ripen fruits, latex seeds –ecconomical value**
- **Total energy -39kcal/100g .**

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Anthracnose in papaya

- *Cause: Colletotrichum gleosporides*
- **Host range – Cereals, grasses, trees, legumes, fruits , vegetables, perennial crops -Ajay Kumar, G., (2014)**
- **Best growth in 29-30ºC, higher humid period.**
- **Spores in quiescent stage - unfavorable condition**

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SYMPTOMS OF ANTHRACNOSE

Sunken, water soaked spots

Round- oval regular - irregular brownish red - black spots

Ajay Kumar, G., (2014)

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Justification for this research

- Anthracnose disease reduce
  - Fruits quality parameters
  - Economy value of the fruits
- Reduce the fungicides usage .
- Increase the self life of papaya fruits

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Objectives

In-vivo **analysis of botanicals coating against papaya anthracnose with wax coating effect on papaya anthracnose**

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MATERIALS & METHODOLOGY

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Extraction of Botanicals

Disease free fresh plants collectedand dried

Washed and surface sterilized 3% NaOCl and dried

made into powder -motor and pestle

Ethanol based solvent extraction and filtration (Muryati *et al.*, 2012)

Prepared 20% of each plant extract

Experimental setup

Treatment Number	Treatment-Set 1	Treatment-Set 2
T1	*Ocimum basilicum*	*Ocimum basilicum* + wax
T2	*Ocimum tenuiforum*	*Ocimum tenuiforum* + wax
T3	*Allium sativum*	*Allium sativum* + wax
T4	*Azadiracta indica*	*Azadiracta indica* + wax
T5	*Lantana camara*	*Lantana camara* + wax
T6	*Ocimum cinnamon*	*Ocimum cinnamon* + wax
T7	Control (surface sterilized organic fruit)	Control + wax

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In-vivo analysis of botanicals and Wax coating against papaya Anthracnose

Uniform color, size papaya fruits collected

↓

Surface cleaning (3% NaOcl)

↓

Topical application of botanical extracts (20%)

↓

Edible wax coating (kept for 4hrs)

↓

Inoculation of *C. gloeosporioides* (x10^8 spores/mL)

↓

Incubation and disease assessment

Assessment and Calculations

$$\textbf{Disease Incidence } \% = \frac{\text{Number of fruits infected}}{\text{Total number of fruits examined}} \; x \; 100 \; \%$$

$$\textbf{Disease severity } = \frac{\text{Value of Grade } \mathbf{X} \text{ No fruits infection}}{\text{Number of fruits examined } \mathbf{X} \text{ Maximum score value}} \; x \; 100 \; \%$$

$$\textbf{Weight loss } \% = \frac{\text{weight of fresh fruit (g)} - \text{ weight of fruit after treatment}}{\text{Weight of fresh fruits (g)}} \; x \; 100 \; \%$$

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Percentage of disease in fruits	Rating scale
0% area affected	0
0-20% area affected	1
21-400% area affected	2
41-60% area affected	3
61-80% area affected	4
80-100% area affected	5

Oniha, M. *et al.*,2015

Analysis pH and Total Soluble Solids (TSS)

Fruit juice preparation

↓

pH meter calibrated
Buffer (pH-4,7)

↓

Reading recoded

Fruit juice preparation

↓

Placed on the prism

↓

Brix reading was recorded

Statistical Analysis

- Data collected in the whole study was analyzed by Micrsoft Excel 2013 and SAS software (9.1 version).

- Duncan's Multiple Ranges Test (DMRT) was used to determine the least significant differences among the treatments at $P > 0.05$.

RESULTS & DISCUSSION

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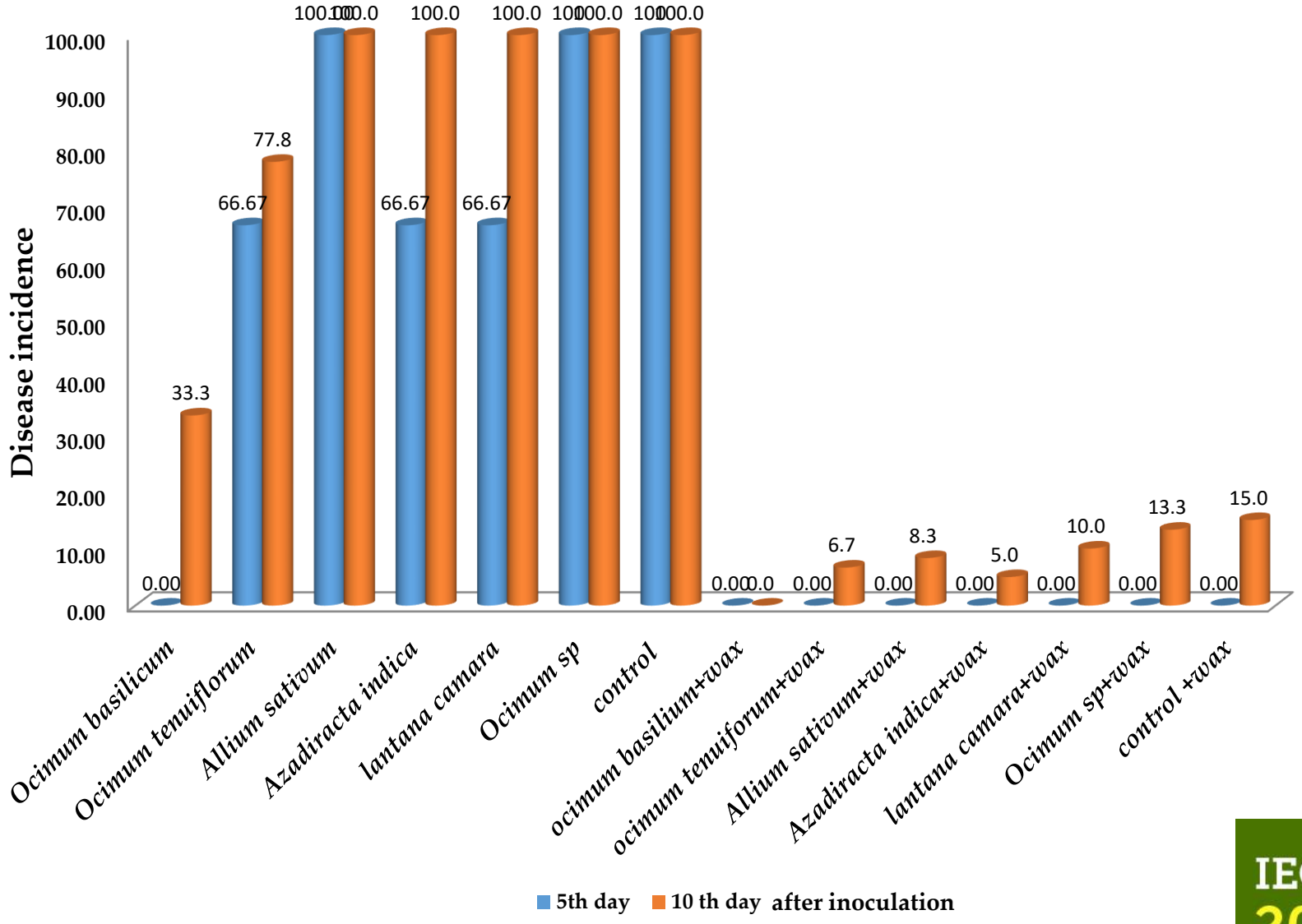
Disease incidence with and without wax



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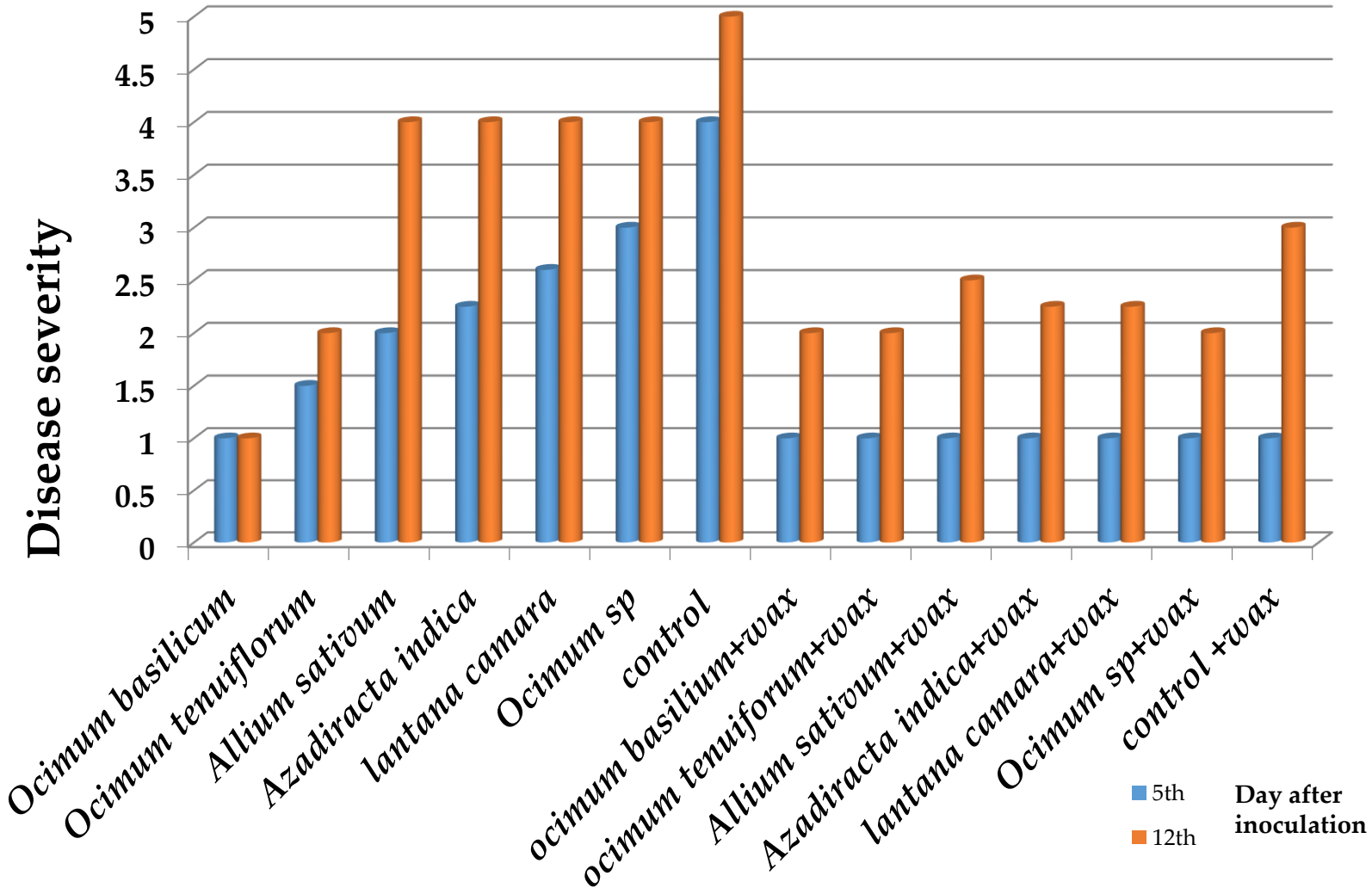
Disease severity with and without wax



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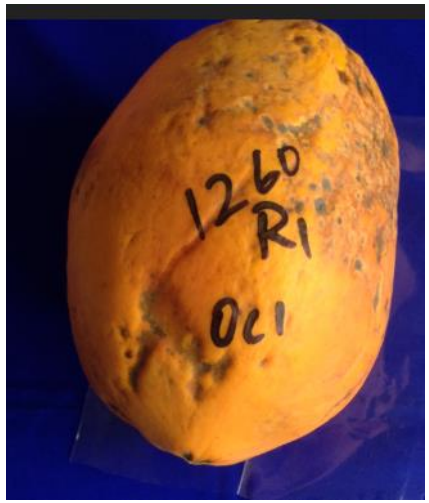
control

lantana camara

Ocimum sp (Kanchang kuthirai

Azadiracta indica

Allium sativum



Ocimum tenuiflorum

Ocimum basilicum

control +wax

Allium sativum+wax

ocimum tenuiforum+wax

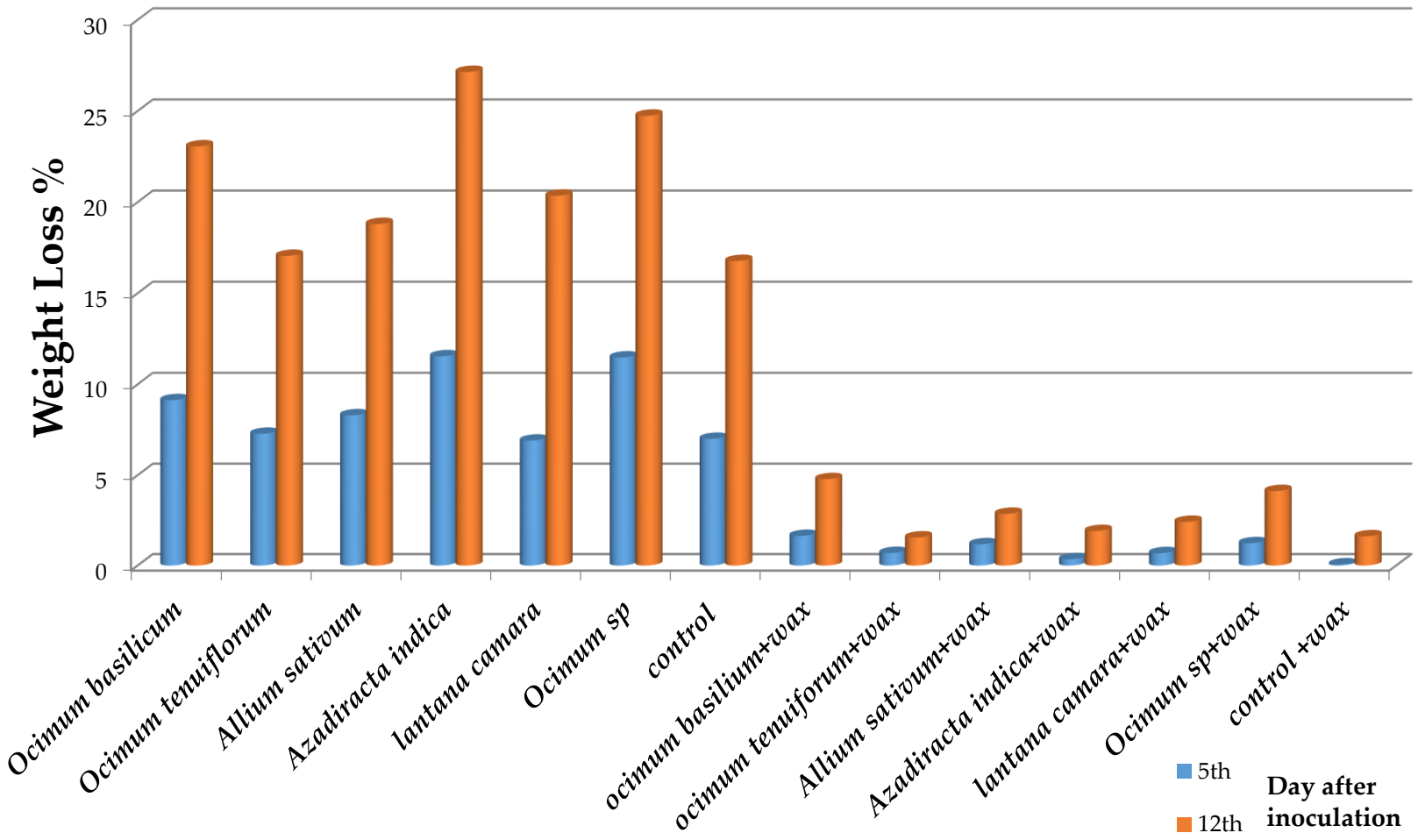
lantana camara+wax

Azadiracta indica+wax

ocimum basilium+wax

Ocimum sp+wax)

weight loss% with and without wax



Botanicals	pH after preservation		TSS after preservation	
	5th day	12th day	5th day	12th day
Ocimum basilicum	5.32±0.35 ^{Aa}	5.42±0.059 ^{Adc}	10.10±0.57^{Bbc}	12.44±0.57^{Acb}
O. tenuiflorum	5.28±0.04^{Aa}	5.50±0.17 ^{Ac}	9.77^{Bbc}	11.48±0.170^{Afed}
Allium sativum	5.11±0.18 ^{Bcd}	5.339±0.29 ^{Abc}	9.10±0.57^{Bc}	11.63±0.25^{Aced}
Azadiracta indica	5.01±0.086 ^{Bcd}	5.55±0.036 ^{Abc}	10.77^{Bbac}	12.58±0.15^{Ab}
Lantana camara	5.26±0.078 ^{Ba}	5.92±0.022^{Aa}	9.73±1.75^{Bbc}	12.14±0.63^{Acbd}
O. cinnamon	4.83±0.01^{Bfed}	5.23±0.173 ^{Ad}	11.33±2.21^{Bba}	13.37±1.22^{Aa}
control	4.88±0.088 ^{Bced}	5.51±0.11 ^{Ac}	11.80±0.15^{Ba}	13.67±0.1^{Aa}
***O. basilium* +wax**	4.822±0.002 ^{Bfed}	5.77±0.133 ^{Aba}	10.40±1.09^{Bbac}	10.78±0.005^{Afeg}
***O. tenuiforum* +wax**	4.97±0.061^{Bced}	5.78±0.026 ^{Aba}	9.59±0.23^{Bc}	10.77±0.05^{Afeg}
***A. sativum* +wax**	4.53±0.056 ^{Bg}	5.79±0.26 ^{Aba}	10.103±0.65^{Bbc}	11.51±0.22^{Afed}
***A. indica* +wax**	5.02±0.009 ^{Bcd}	5.84±0.0569 ^{Aa}	9.59±0.24^{Bc}	11.85±0.085^{Acbd}
***Lantana camara* +wax**	4.71±0.076 ^{Bf}	5.44±0.0152 ^{Adc}	9.63±0.10^{Bc}	10.61±0.33 ^{Acbd}
***O. cinnamon* +wax**	4.80±0.072 ^{Bfed}	5.40±0.168 ^{Adc}	9.51±0.42^{Bc}	10.53±0.35^{Ag}
Control +wax	4.36±0.02 ^{Bh}	5.77±0.55 ^{Aba}	10.29±0.25^{Bc}	11.55±0.69^{Afed}

Conclusions

- Botanicals plays a role as fungicides ,*Ocimum basilicum*. *Ocimum tenuiforum* can be used as natural fungicides for papaya anthracnose.

- Wax coating increase the self life of papya, but it reduce the ripening process.

Acknowledgments

Thank you

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