



# CERTIFICATE

This certificate proudly present to:

**Widi Sunaryo**

In recognition of his/her valuable participation in  
**International Conference on Tropical Agrifood, Feed and Fuel (ICTAFF)**  
**Mesra Business & Resort Hotel Samarinda, November 13-14th, 2018** as a :

**KEYNOTE SPEAKER**

Dean Of Faculty Of Agriculture



Dr. Ir. H. Rusdiansyah, M.Si

Chairman



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# Improvement of the superior local fruits from East Kalimantan using genetic, physiological and agronomical approaches

*Lai-durian*

**Widi Sunaryo, PhD**

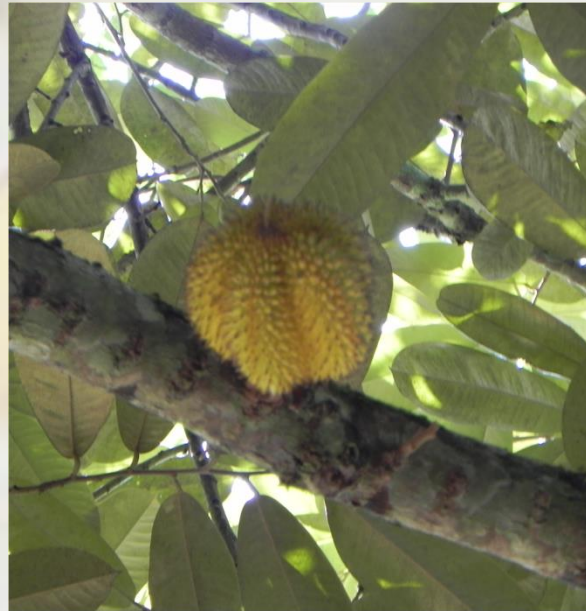
*Presented in International Conference on Tropical Agrifood, Feed and Fuel Samarinda, 13-14 Nopember 2018*



# Current Update and Background



*Durio zibethinus* (Durian),  
Sunaryo et al., 2014



*Durio kutejensis* (Lai, Pampaken),  
Sunaryo et al., 2014



*Durio excelsus* (Apun),  
Year of Durian, 2013

- Most of genetic resources and species diversity of *Durio spp* was reported existing in Kalimantan Island.
- From a total 20 *Durio* species encountered in Indonesia, 18 species occur in Kalimantan (Uji, 2005)

# Current Update and Background



*Durio dulcis* (Lahong),  
Year of Durian, 2013



*Durio oxyleanus* (Kerantungan),  
Sunaryo et al., 2014



*Durio testudinarum* (Durian Kura2),  
Year of Durian, 2013

- Due to the open pollinated characteristic, the genetic diversity of *Durio spp* is enlarging and spreading significantly
- *Durio spp* is a tropical fruit that can grow at broad range of climate and season

# NUTRITIONAL VALUE OF DURIO SPP

Nutritional Value	<i>D. zibethinus</i>	<i>D. kutejensis</i>	<i>D. graviolens</i>	<i>D. oxleyanus</i>
Energy	128 - 188 Kcal	149 Kcal	152 Kcal	120 Kcal
Sugar	20,18° brix	10,8° brix	19,1° brix	15,2° brix
Protein	3,2%	4,8%	2,6%	7,7%
Lipid	3,2%	2,1%	6,2%	2,1%
Water content	62,7%	58,4%	66,7%	30,3%
Carbohydrates	31,0%	19,9%	21,5%	18,4%
Fibre	3,0%	1,4%	2,0%	1,9%
The percentage of edible part	20,5%	33,9%	30,2%	19,7%
Shelf life at room temperature	7 days	8,6 days	7 days	7 days
P	19,6 - 65,4 mg	25 mg	43 mg	13 mg
K	431,2 - 488,1 mg	362 mg	529 mg	159 mg
Ca	4,5 - 41,5 mg	19 mg	10 mg	3 mg
Mg	33 - 330 mg	19 mg	27 mg	8 mg
Fe	0,38 - 1,9 mg	0,7 mg	0,6 mg	1,7 mg
Mn	0,8 ppm	5,0 ppm	4,0 ppm	1,2 ppm
Cu	1,0 ppm	3,2 ppm	7,0 ppm	2,1 mg
Zn	1,4 ppm	7,3 ppm	5,9 ppm	1,7 mg
Vit. C	22,9 - 107 mg	15,9 mg	10,4 ppm	20,8 mg

Ref: Sunaryo et al (2015); Hoe and Siong, (1997); Brown (1997)

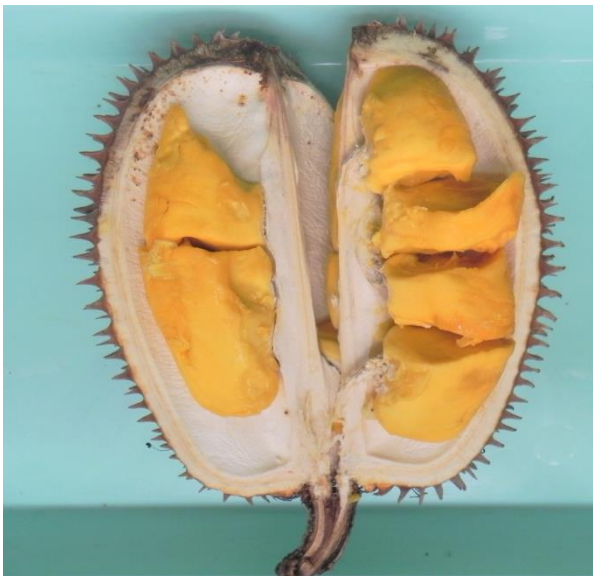


The most popular of edible *Durio* species in East Kalimantan is *Durio zibethinus* (Durian, local name) and *Durio kutejensis* (Lai, Local Name).



*Durio zibethinus* (Durian), general characters:

- ▣ Sweet
- ▣ sharp Odor/fragrant
- ▣ Wet and soft Texture
- ▣ White, white yellowish, yellow, yellow Goldish
- ▣ High alcohol content while ripening
- ▣ High water content



*Durio kutejensis* (Lai, Pampaken), general characters

- ▣ Sweet
- ▣ Odorless/ not fragrant
- ▣ Dry and Dense Texture
- ▣ Yellow until orange
- ▣ No alcohol content while ripening
- ▣ Low water content

# LAI DURIAN: a new variant of *Durio* spp having high potential economic value to be improved as a National Excellent Variety from East Kalimantan



## Remarkable properties and superiority

Sweet, odorless, gold yellowish, low water content, no alcohol, dry and dense texture, abnormal seeds, pink flower, many award from Durian contest. The ripe-fruit does not fall from the tree

**Name:** LAI DURIAN; DURIAN LAI

**Local Name:** Holai, Mandong, Mading

**Origin:** Putative Natural Crossing between *Durio zibethinus* x *Durio kutejensis* (Sunaryo et al. 2015)

**Taxonomy:** *D excelsus* (BPTP, Kaltim), *D. zibethinus*x*kutejensis* (Sunaryo et al. 2015) and *D. Connatus* (Priyanti, 2016)

**Distribution:** East/North Kalimantan

**Economic value:** Preferred by consumer and high price in local market

# PROBLEMS for Lai-durian



- Taxonomy status is still unclear
- Misunderstanding on the origin
- The diversity and distribution is unexplored
- The economic value is still unexplored
- The superior varieties released is still limited developed
- Development cultivation technology.



# Lai-durian research road map 2012-2025

**(2014-2015)**

Exploration, identification, and analysis of DNA Barcoding for Lai Durian (**INSINAS Funding**)

**(2012-2013)**

Eksplorasi Holai Sentawar from Kutai barat (**BPSB Funding**)

**(2016-2017)**

Development of selected genotype and varieties of Lai Durian from Kalimantan Timur: technology of mass clonal propagation, cultivation, and off-season flowering initiation (**INSINAS Funding**)

**(2014-2015)**

Registration and released of national superior variety of Holai Sentawar (**BPSB Funding**)

**(2021-2022)**

Multilocation field test of superior varieties of Lai Durian using mass propagation technology input and off-season flowering initiation (**Research Plan**)

**(2019-2020)**

1. Efficiency of pollination and fruit set to increase the fruit quality and productivity of Lai Durian from Kalimantan Timur as superior local commodity
2. Registration of Geographic indication (IG) (Applied Research, **KEMENRISTEK DIKTI**)

**(2024-2025).**

Commercialization of Lai-Durian as superior local and export commodity (**Research Plan**)

**2023.**

Suplai chain, agribusiness, and added value of Lai Durian for product diversification (**Disperta, Kaltim**)

# Our works and goals

- 1. Taxonomy clarification: exploration, identification, characterization via morphology and genetic analysis**
- 2. Diversity analysis: DNA barcoding and molecular marker**
- 3. Mass vegetative propagation**
- 4. Off-season flowering initiation technology**
- 5. Cultivation technology**
- 6. Efficiency of pollination, fertility and fruit formation investigation**
- 7. Conservation by Geographic indication registration**

# Exploration



Kalimantan Island and East Kalimantan Province

**Lai-durian is existing in 6 Districts of East/North Kalimantan**



# Lai-durian variants from east/north kalimantan

A	B	C	D
No.	Local Name	Origin	Status
1.	Holai Sentawar	Kutai Barat	National Superior Variety
2.	Lai Mandong	Kutai Kertanegara	National Superior Variety
3.	Lai Durian Mading	Kutai Kertanegara	Local Variety
3.	Lai Kayan	Bulungan	National Superior Variety
4.	Durian Lai Samarinda	Samarinda	Local Variety
5.	Durian Pagaluyon	Nunukan	Local Variety
E	6. Lai Durian Berau	Berau	Local Variety
	7. Durian Lai Balikpapan	Balikpapan	Local Variety

**Note:** A and E: Lai Kayan (Bulungan), B and F: Durian Lai (Samarinda), C and G: Holai Sentawar (Kutai Barat), and D and H: Lai Durian (Balikpapan). (Sunaryo, et al., 2015)

# Lai Durian Flower and Aril: Intermediate phenotype of its parents

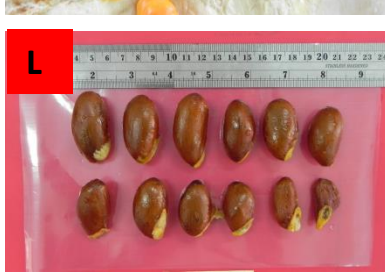
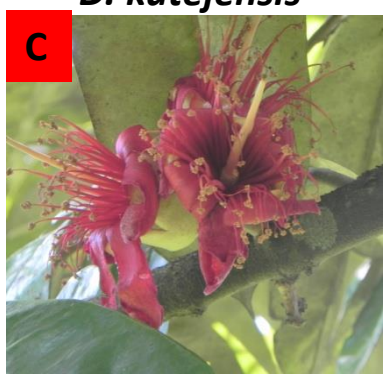
*D. zibethinus*



Lai Durian



*D. kutejensis*





# Example of data collection and leaf morphological identification

<b>Kabupaten</b>	KUTAI BARAT
1. No. Sampel	1 C (Nomor Foto: 2801-2817)
2. Nama varietas (lokal)	Holai / Lai sentawar / Lai durian
3. Lokasi (Koordinat / GPS)	S 00°08.610' E115°34.641' ±2
4. Nama Desa / Kampung	Bigung baru, Kec. Linggang bigung



*D. zibethinus*

Lai Durian

*D. kutejensis*

**Note:**  
 LA: Leaf Apex    LM: Leaf Margin    LB: Leaf Base    P: Petiole



# Morphological Characters analysis: strongly indicates that *Lai Durian* originated from natural crossing between *D. zibethinus* and *D. kutejensis*

No.	Observed Morphological Characters	<i>Durio zibethinus</i>	<i>Lai Durian</i>	<i>Durio kutejensis</i>
1.	Mean value of leaf length (cm)	15,94 ± 3,13	21,12 ± 4,71	26,42 ± 4,59
2.	Mean value of leaf width (cm)	5,25 ± 1,18	7,60 ± 1,98	10,06 ± 2,00
3.	Mean value of petiole (cm)	1,88 ± 0,62	2,25 ± 0,42	2,40 ± 0,57
4.	Flower colour (number of samples)			
	White	30 (100 %)	0 (0%)	0 (0%)
	Pink	0 (0 %)	26 (100%)	0 (0%)
	Red	0 (0 %)	0 (0%)	23 (100%)
5.	Leaf shape (number of samples)			
	Oblong	17 (57 %)	15 (57 %)	18 (78 %)
	Ovate	8 ( 27 %)	7 (27 %)	0 (0 %)
	Obovate	4 (13 %)	2 (8 %)	4 (17 %)
	Elliptic	1 (3 %)	2 (8 %)	1 (5 %)
6.	Leaf apex (number of samples)			
	Long	20 (67 %)	1 (4 %)	1 (5 %)
	Medium	5 (17 %)	14 (54 %)	7 (30 %)
	Short	5 (17 %)	11 (42 %)	15 (65 %)
7.	Leaf base (number of samples)			
	attenuate	20 (67 %)	14 (54 %)	16 (69 %)
	Rounded	1 (3 %)	1 (4 %)	2 (9 %)
	Obtuse	9 (30 %)	11 (42 %)	5 (22 %)

# Morphological Characters analysis: strongly indicates that *Lai Durian* originated from natural crossing between *D. zibethinus* and *D. kutejensis*

8.	<b>Leaf margin (number of samples)</b>			
	Entire	30 (100 %)	26 (100 %)	23 (100 %)
	Crenate	0 (0 %)	0 (0 %)	0 (0 %)
9.	<b>Upper leaf color (number of samples)</b>			
	Dark green	8 (27 %)	1 (4 %)	2 (9 %)
	Green	15 (50 %)	19 (73 %)	13 (57 %)
	Light green	7 (23 %)	6 (23 %)	8 (34 %)
10.	<b>Lower leaf color (number of samples)</b>			
	Silvery	2 (7 %)	4 (15 %)	0 (0 %)
	Brownish silver	8 (27 %)	5 (19 %)	10 (43 %)
	Brownish	1 (3 %)	1 (4 %)	0 (0 %)
	Gray	19 (63 %)	16 (62 %)	13 (57 %)
11.	<b>Branching Architecture (number of samples)</b>			
	High looming	26 (86 %)	8 (31 %)	8 (34 %)
	Umbrella-shaped	2 (7 %)	14 (54 %)	11 (49 %)
	Irregular shape	2 (7 %)	4 (15 %)	4 (17 %)
12.	<b>Branching Direction (number of samples)</b>			
	Upward pointing	12 (40 %)	11 (42 %)	2 (9 %)
	Horizontal pointing	10 (33 %)	9 (35 %)	10 (43 %)
	Downward Pointing	7 (24 %)	2 (8 %)	7 (31 %)
	<b>Branching Angle (number of samples)</b>	1 (3 %)	4 (15 %)	4 (17 %)
13.	Acute			
	Straight	19 (63 %)	21 (81 %)	15 (65 %)
	Obtuse/Blunt	4 (13 %)	1 (4 %)	3 (13 %)
	<b>Leaf margin (number of samples)</b>	7 (24 %)	4 (15 %)	5 (22 %)
	<b>Total number of samples</b>	<b>30</b>	<b>26</b>	<b>23</b>

*Lai Durian fruit has positive combination properties originated from its parents (D. zibethinus and D. kutejensis) and more preferred by consumers.*

<b>Nutritional and fruit properties</b>	<i>Durio zibethinus</i>	<i>Lai Durian</i>	<i>Durio kutejensis</i>
Sugar	20,18° brix	17,5° brix	10,8° brix
Protein	3,21 %	6,60 %	4,81 %
Lipid	3,18 %	2,23 %	2,05 %
Water content	62,70 %	57,10 %	58,36 %
Carbohydrates	30,98 %	20,00 %	19,87 %
Fibre	3,04 %	2,5 %	1,35 %
Aril thickness	0,79 %	1,01 %	0,90 %
Aril color	White-yellowish	Yellow-golden yellow	Yellow -orange
The percentage of edible part	20,51 %	28,16 %	33,85 %
Shelf life at room temperature	7 days	8 days	8,6 days
Texture	Smooth, Soft and Wet	Smooth, Dense and Dry	Smooth, Dense and Dry
Aroma	Sharply fragrant	Not fragrant	Not fragrant
Sweetness	Sweet	Sweet	Less sweet
Sugar	20,18° brix	17,5° brix	10,8° brix



# Taxonomy clarification and outlook

1. Based on plant morphology, fruit performance, and nutritional value analysis, there is strong indication that *Lai Durian* is originated from the natural crossing of *D. zibethinus* and *D. Kutejensis*.
2. *Lai Durian* fruit has positive combination properties originated from its parents (*D. zibethinus* and *D. kutejensis*) such as sweet (high sugar content), thick and attractive color (yellow) aril, soft and dry texture (low water and fiber content), not fragrant, high protein content, long shelf life at room temperature, and high percentage of the edible fruit part that are more preferred by consumers.

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## EXPLORATION AND IDENTIFICATION OF LAI DURIAN, NEW HIGHLY ECONOMIC POTENTIAL CULTIVARS DERIVED FROM NATURAL CROSSING BETWEEN DURIO ZIBETHINUS AND DURIO KUTEJENSIS IN EAST KALIMANTAN

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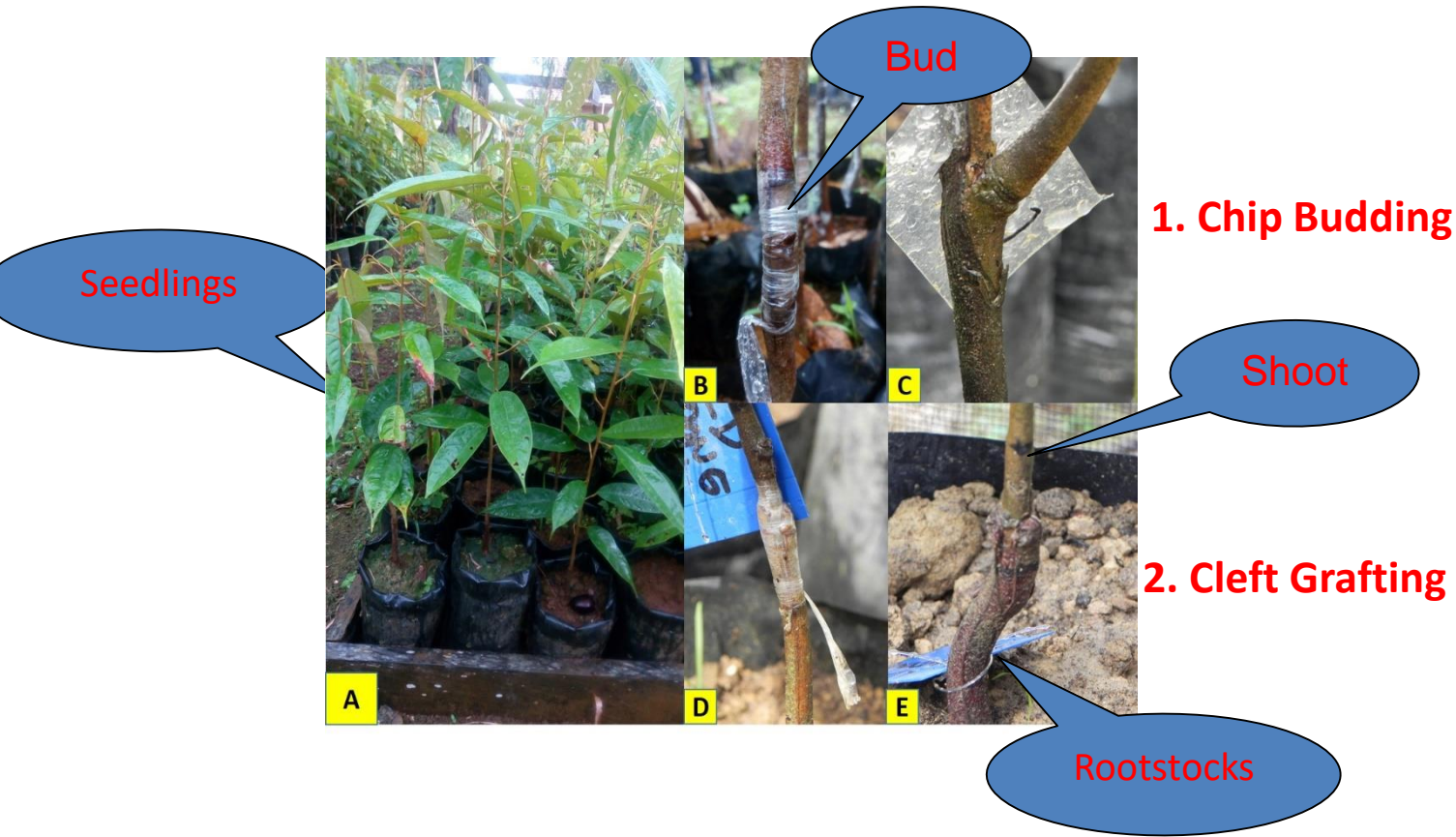
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# Mass vegetative propagation

1. *Durio sp.* is an open polinated / cross polinated plant.
2. Clonal propagation insures the genetic similarity of plant materials.
3. Limited seeds as rootstock sources for clonal propagation since most seed produced by lai-durian are abnormal.
4. In practice, people use seedling from Durian or Lai as rootstock sources.
5. *The grafting suitability between scions and rootstocks of such practice are uninvestigated and questioned.*

# Vegetative propagation model/techniques



## Experiment design and materials

No.	Scion (Lai-durian varieties)	Rootstocks (Randomly selected seedlings)	Replication	Total Experiment
1.	Holai Sentawar	Durian, Lai, Lai Durian	20 times	60 seedlings
2.	Lai Mandong	Durian, Lai, Lai Durian	20 times	60 seedlings
3.	Lai Kayan	Durian, Lai, Lai Durian	20 times	60 seedlings

## Plant growth and the successful grafting of two different grafting model in Lai-durian after 56 days (8 weeks) of observation.

Observed Variables	Cleft Grafting	Chip Budding	t test
Plant height increment (cm)	8.82	10.48	*
Scion/shoot diameter increment (cm)	1.09	1.37	*
Rootstocks diameter increment (cm)	1.00	1.27	*
Leaf number increment	9.22	4.60	**
Branch number increment	3.48	2.46	*
Percentage of the success grafting (%)	60.00	94.00	**
Time for success grafting (days)	76.56	17.43	**

Note: \*\* = significant at  $p \leq 0,01$  , \* = significant at  $p \leq 0.05$ , NS = Not Significant

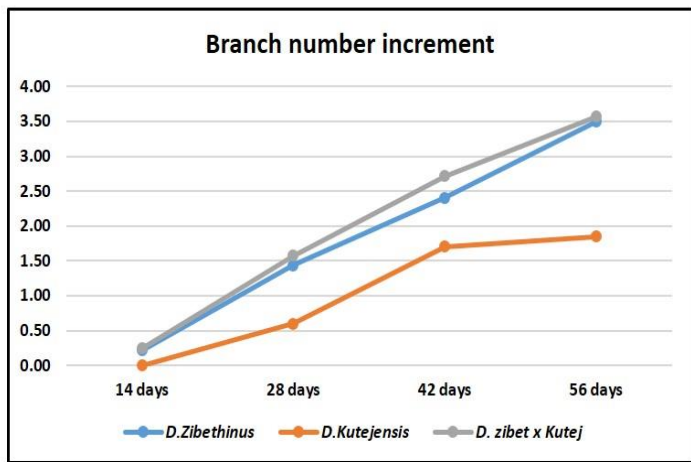
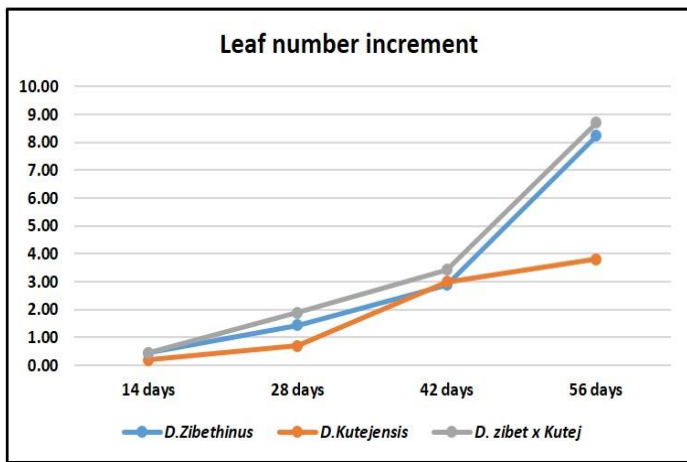
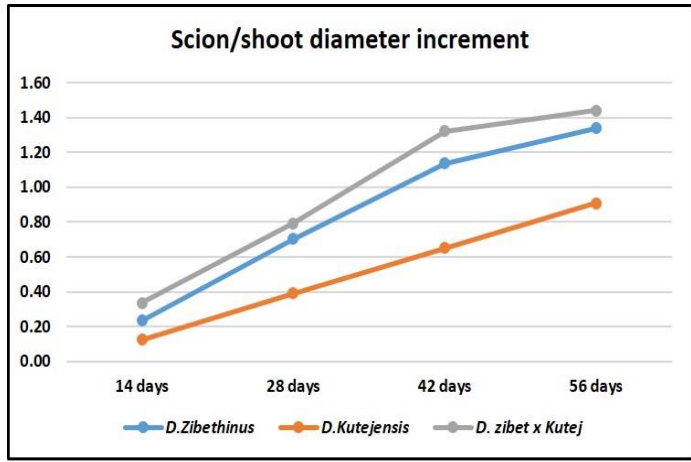
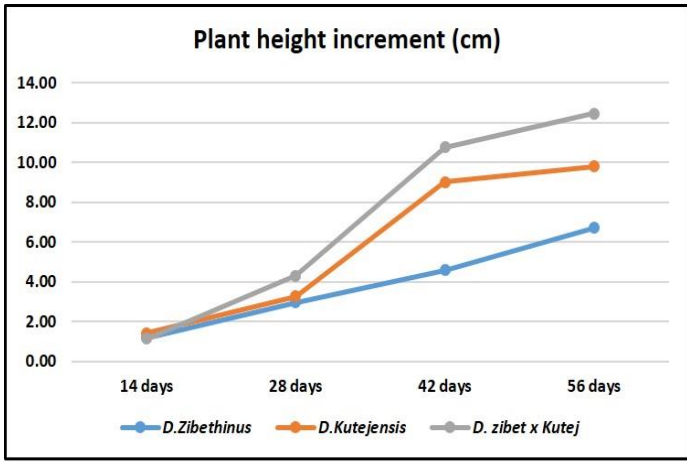


## Plant growth and the successful grafting of two different grafting model in Lai-durian after 56 days (8 weeks) of observation.

Growth Variables	<i>D. Zibethinus</i>	<i>D. kutejensis</i>	<i>D. zibet x kutej</i>	Anova
<b><i>Cleft grafting</i></b>				
Plant height increment	7.29 a	8.06 a	11.12 b	*
Scion/shoot diameter increment	1.01 b	0.68 a	1.29 c	*
Rootstocks diameter increment	0.99 a	0.74 a	1.29 b	**
Leaf number increment	10.41 b	5.49 a	11.77 b	**
Branch number increment	3.74 b	2.68 a	4.02 c	*
Percentage of the success grafting (%)	56 a	61 a	63 a	NS
Time for success grafting	76.36 a	77.6 a	75.71 a	NS
<b><i>Chip budding</i></b>				
Plant height increment	6.14 a	11.54 b	13.76 b	**
Scions diameter increment	1.37 a	1.13 a	1.31 a	NS
Rootstock diameter increment	1.24 a	1.37 a	1.21 a	NS
Leaf number increment	6.05 b	2.11 a	5.65 b	**
Branch number increment	3.25 b	1.02 a	3.12 b	*
Percentage of the success grafting	95 a	90 a	97 a	NS
Time for success grafting	17.23 a	18.3 a	16.75 a	NS

Note: \*\* = significant at  $p \leq 0,01$  , \* = significant at  $p \leq 0.05$ , NS = Not Significant

The growth pattern of Lai-durian grafted using three different grafting rootstocks (*D. Zibethinus*, *D. Kutejensis*, and *D. zibethinus x kutejensis*).



# The scion and rootstock suitability of the grafting in *Durio spp.* indicated by the growth of stem diameter increment.

Scions Sources	Rootstocks Sources	Scions Diameter Increment (cm)	Rootstocks Diameter Increment (cm)	Anova
<b><i>Cleft grafting</i></b>				
<b>Lai Kayan</b>	<i>D. zibethinus</i>	1.04	0.98	NS
	<i>D. kutejensis</i>	0.51	0.82	*
	<i>D. zibethinus x kutejensis</i>	1.20	1.33	NS
<b>Lai Mandong</b>	<i>D. zibethinus</i>	1.21	1.08	NS
	<i>D. kutejensis</i>	0.82	0.72	NS
	<i>D. zibethinus x kutejensis</i>	1.33	1.09	*
<b>Holai Sentawar</b>	<i>D. zibethinus</i>	0.79	0.90	NS
	<i>D. kutejensis</i>	0.75	0.69	NS
	<i>D. zibethinus x kutejensis</i>	1.33	1.45	NS
<b><i>Chip budding</i></b>				
<b>Lai Kayan</b>	<i>D. zibethinus</i>	1.45	1.11	**
	<i>D. kutejensis</i>	1.14	1.52	**
	<i>D. zibethinus x kutejensis</i>	1.29	1.31	NS
<b>Lai Mandong</b>	<i>D. zibethinus</i>	1.44	0.96	**
	<i>D. kutejensis</i>	1.22	1.30	*
	<i>D. zibethinus x kutejensis</i>	1.33	1.23	NS
<b>Holai Sentawar</b>	<i>D. zibethinus</i>	1.23	1.65	**
	<i>D. kutejensis</i>	1.02	1.27	*
	<i>D. zibethinus x kutejensis</i>	1.31	1.30	NS

Note: \*\* = significant at  $p \leq 0,01$  , \* = significant at  $p \leq 0.05$ , NS = Not Significant



# Mass Propagation Recommendation

1. The chip budding had a higher percentage of successful grafting in a faster time compared to the cleft grafting.
2. Interspecific grafting between *D. zibethinus x kutejensis* as scion/bud sources and *D. zibethinus* or *D. kutejensis* as rootstocks was compatible and successful to make graft union.
3. The use of *D. zibethinus x kutejensis* rootstocks (homograft) resulted in the highest grafted plant growth compared to *D. zibethinus* or *D. kutejensis* rootstocks (heterograft).
4. The interspecific grafting of Lai-durian using *D. zibethinus* could be recommended as an effective alternative rootstock source in the mass-clonal propagation to overcome the limited number of Lai Durian seeds.

**Interspecific grafting of superior varieties of Lai-durian (*Durio zibethinus x kutejensis*) from East Kalimantan using different rootstocks**

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**Keywords:** Interspecific, grafting, Lai-durian, compatibility, rootstocks, East Kalimantan

# Off-season flowering initiation of Lai-Durian

1. Maximum production is reached at very limited and specific area/micro climate plantation.
2. The production is season-depended influencing the flowering initiation and fruit set formation.
3. Flowering initiation in durio sp involves the plant growth regulator transitions triggering the developmental transition processes (Crane 1969; Mutasa-Goettgens and Hedden, 2009).
4. Gibberelins (GAs) inhibition play inportant role in flowering initiation (Crane 1969; Erickson et al. 2006; Mutasa-Goettgens and Hedden, 2009; Randoux et al. 2012).
5. Some Plant growth regulators (*Especially Retardant*) can triger flowering initiation by inhibition of Gibberellins accumulation. Such as Paclobutrazol, Prohexadione-Ca, Auxins (Crane 1969; Darmawan et al. 2014;.
6. Environmental stress such as pest and disease attack/infection, water stress, mechanical wounds can also trigger flowering initiation.
7. Strangulation) could trigger flowering initiation by inhibitiation of photosyntate transportation in the plant stem (Susanto et al. 2002; Putra 2002)

# Methods:

Treatment	Concentration/Dosage	Application	References
Control	-	-	-
Paclobutrazol	2 g/plant in 1 L water	Flushing to the soil surrounded the plant	Efendi (1994), Susanto & Poerwanto 1999, Sakhidi et al. (2011)
Prohexadione-Ca	500 ppm/plant in 1 L water	Spraying to the leaves	Kofidis et al 2008
Strangulation	2 mm-iron wire coiled 3 times for 1 month	At the main stem 1 meter above soil surface	Susanto et al. (2002) Putra (2002)
Gibberelin (GA3)	20 ppm	Spraying to the leaves	Hasan et al. (2010)

## Methods: Organic fertilization before treatment





## Methods: Anorganic fertilization before treatment





## Methods: mechanical treatment (strangulation)





# Methods: Plant growth retardant treatment (spraying)



## Off- season flowering initiation

Flowering Induction treatment	Flowering Time (Days)	Number of Flower per Plant	Number of Fruit per Plant	Fruit Set (%)
Control (No Treatment)	0	0	0	0
Paclobutrazole	27.44	792	67	8.45
Prohexadione-Ca	30.54	437	83	18.99
Strangulation	0	0	0	0
Gibberelin (GA <sub>3</sub> )	35.12	342	54	15.79

## Productivity of lai-durian varieties of Mandong due to the initiation treatment

Flowering Induction treatment	Number of Immature Fruit per plant	Number of Harvested Fruit per Plant	Average of Fruit weight (g)	Seed number per Fruit	Fruit Quality (*)
Control (No Treatment)	0	0	0	0	5
Paclobutrazole	67	32	1845.12	28.33	1
Prohexadione-Ca	83	47	1796.23	31.67	2
Strangulation	0	0	0	0	5
Gibberelin (GA <sub>3</sub> )	54	33	1941.41	30.33	1

Note : All values is the average from 4 sample plants , 1. Big fruit, full and perfect, 2. Fruits Medium full and perfect, 3. Fruitful small, full and perfect 4. Abnormal fruit, and not full, 5. Not bear fruit.



**Flowering initiation of Lai-Durian: A. Developing flower bud B. Immature flower.**



**A**

**B**

**Flower and fruit development: A. Mature flower B. Developing flower bud B. Developing fruit.**





Fowering development: A. Flower set B. Fruit set.



Fruit development: A. Immature fruit B. Mature Fruit.





# Off-season Initiation recommendation

- All off-season flowering treatments could trigger the Lai-durian flowering and fruit set formation successfully except for strangulation.
- Ca-prohexadion treatment could produce the highest number of harvested fruit per plant
- Optimum Dosage: 60 kg organic fertilizer per plant per year + 60 kg Dolomit per plant per year + 500 kg NPK (15 N 15 P 15 K) per plant per year + Micro fertilizer (Mn, Cu, Zn, dan Bo) as recommendation dosage.

## Off-season flowering initiation of Lai-Durian (*Durio zibethinus x kutejensis*) from East Kalimantan using growth regulator and mechanical manipulation

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\*) Center of excellence of Peatland Research, Kalimantan University Consortium, Indonesia

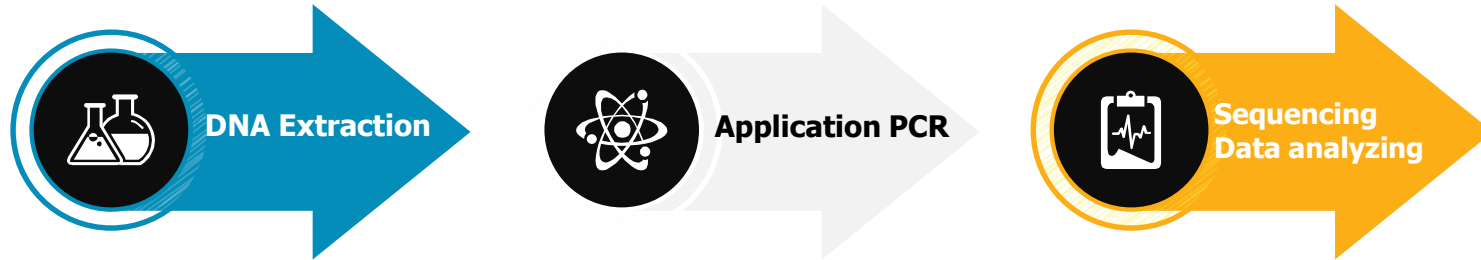
### Abstract

The limited factor in increasing most local fruits mainly *Durio spp.* is season-dependent factors influencing the flowering initiation and fruit set formation. Flowering involve in plants generally involves the plant growth regulator transitions triggering the developmental transition processes. This research report the off-season flowering initiation of Lai-Durian (*Durio zibethinus x kutejensis*) from East Kalimantan using plant growth regulator and mechanical manipulation such as Gibberellin (GA<sub>3</sub>), Paclobutrazol (retardant), Prohexadione-ca (retardant), and stem strangulation (mechanical treatment). GA<sub>3</sub> was applied at 20

# Diversity analysis using DNA barcoding

- 1. Taxonomy status is unclear: misunderstanding on the origin, the diversity and distribution is unexplored.**
- 2. Identification of plants using a short sequence of genes whose position in the genome has been standardized (mutually agreed) which is called as " DNABarcode".**
- 3. Alternative plant identification that is fast, accurate, and not ambiguous (biased).**
- 4. Requires a small number of samples and in principle DNA can be taken from any part of the plant**

# Ongoing: Diversity analysis using DNA barcoding



## Primers used for Durio DNA Barcoding

Primer/Gene	Sequences	Amplicon length (bp)	References
rbclLa Forward rbclLa Reverse	ATGTCACCACAAACAGAGACTAAAGC GTAAAATCAAGTCCACCRCG	530	Levin et al. 2003; Kress and Erickson, 2007
matK-390 Forward matK-1326 Reverse	CGATCTATTCATTCAATATTTTC TCTAGCACACGAAAGTCGAAGT	501	Cuenoud et al., 2002
trnH (GUG) Forward psbA Reverse	ACTGCCTTGATCCACTTGGC CGAAGCTCCATCTACAAATGG	373	Hamilton, 1999.

# Samples

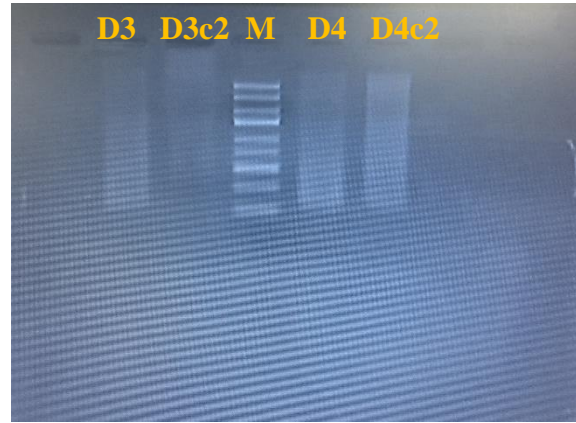
## Samples

1. Durian (*Durio zibethinus*)
2. Lai (*Durio Kutejensis*)
3. Lai-Durian Mandong
4. Lai-Durian Kayan
5. Lai-Durian Holai Sentawar
6. Lai-Durian Samarinda

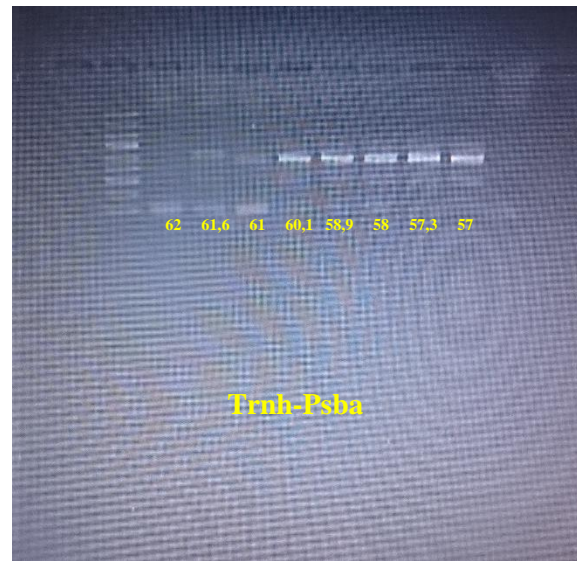


# DNA quantity and quality

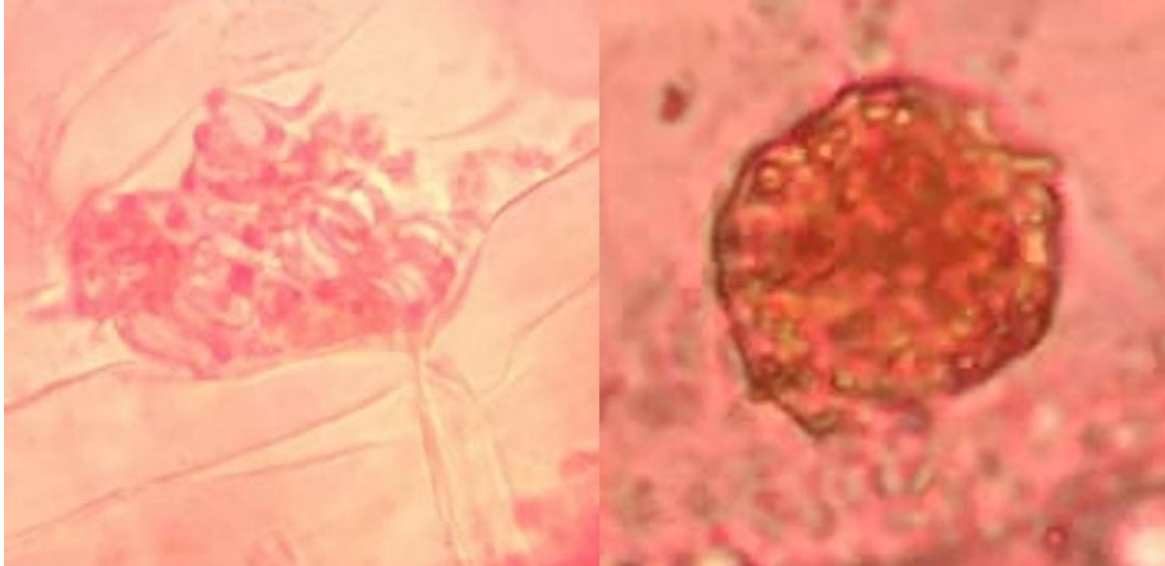
## Result of DNA extraction in Durian



# Amplification using RbcI and Trn-PsBa primer is successfully done with certain PCR conditions



# Ongoing: Chromosome analysis for Allopolyploidy investigation



**Chromosome analysis is still not reliable, the improvement of the methods is still in progress**



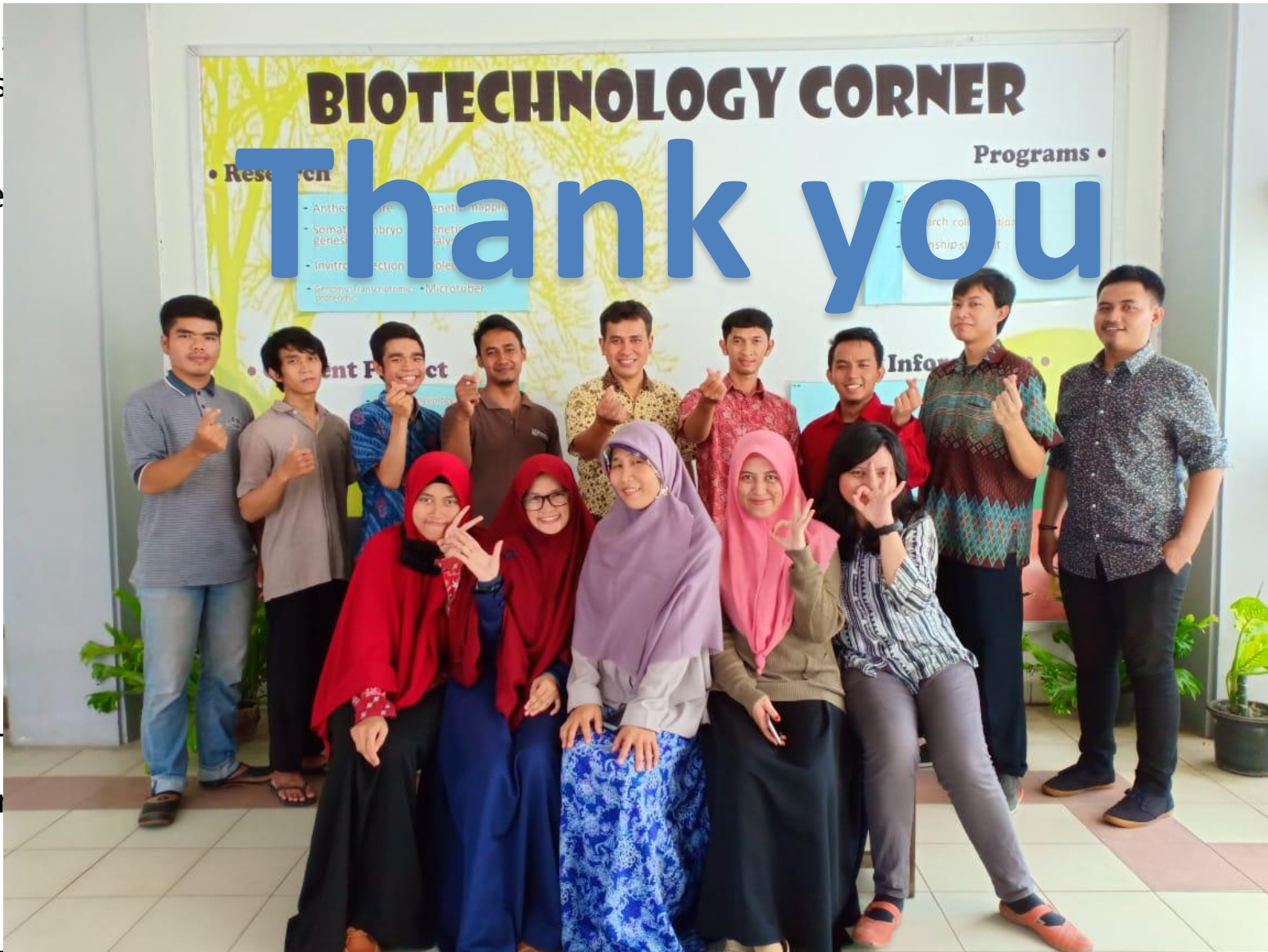
# Acknowledgement

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# FRUIT PERFORMANCE OF DURIO SPP



***Durio zibethinus* (Durian),**

Sunaryo et al. (2015)

- Δ Size: small – very big
- Δ Flesh: thick - very thick
- Δ Flesh Colour: White – yellowish
- Δ Odorness: medium – very sharp
- Δ Alcohol content: medium – very high
- Δ Texture : soft, wet
- Δ Water Content: high
- Δ Taste: Sweet – bitter
- Δ Shelf life : short - long



***Durio kutejensis* (Lai, Pampaken),**

Sunaryo et al. (2015)

- Δ Size: small – small -medium
- Δ Flesh: thick - very thick
- Δ Flesh Colour: orange
- Δ Odorness: odorless
- Δ Alcohol content: no alkohol
- Δ Texture : soft, dry
- Δ Water Content: low
- Δ Taste: medium - sweet
- Δ Shelf life : very long



***Durio excelsus* (Apun),**

Year of Durian, (2013)

- Δ Size: very small
- Δ Flesh: thin
- Δ Flesh Colour: orange
- Δ Odorness: odorless
- Δ Alcohol content: no alkohol
- Δ Texture : soft, dry
- Δ Water Content: low
- Δ Taste: medium - sweet
- Δ Shelf life : very short



# FRUIT PERFORMANCE OF DURIO SPP



***Durio dulcis* (Lahong),**  
Year of Durian (2013)

- Δ Size: medium
- Δ Flesh: thin
- Δ Flesh Colour: white - yellowish
- Δ Odoriness: odorless - medium
- Δ Alcohol content: medium
- Δ Texture : soft, wet
- Δ Water Content: high
- Δ Taste: medium - sweet
- Δ Shelf life : short - medium



***Durio oxleyanus* (Kerantungan),**  
Year of Durian (2013)

- Δ Size: small
- Δ Flesh: thin - thick
- Δ Flesh Colour: yellowish
- Δ Odoriness: odorless - medium
- Δ Alcohol content: medium
- Δ Texture : soft, wet
- Δ Water Content: high
- Δ Taste: medium - sweet
- Δ Shelf life : short - medium



***Durio testudinarum* (Durian Kura2),**  
Year of Durian (2013)

- Δ Size: small
- Δ Flesh: thin
- Δ Flesh Colour: white - yellowish
- Δ Odoriness: sharp
- Δ Alcohol content: high
- Δ Texture : soft, wet
- Δ Water Content: high
- Δ Taste: medium – sweet - bitter
- Δ Shelf life : short - medium



# FRUIT PERFORMANCE OF DURIO SPP



***Durio glandiforus* (Sukang),**  
Year of Durian (2013)

- Δ Size: small
- Δ Flesh: thin
- Δ Flesh Colour: Dark red
- Δ Odoriness: odorless - medium
- Δ Alkhol content: medium
- Δ Texture : soft, dry
- Δ Water Content: low
- Δ Taste: medium - sweet
- Δ Shelf life : short - medium



***Durio graveolens* ( Red),**  
Year of Durian (2013)

- Δ Size: small
- Δ Flesh: thick
- Δ Flesh Colour: Dark red
- Δ Odoriness: odorless
- Δ Alkhol content: no alkohol
- Δ Texture : soft, dry
- Δ Water Content: low
- Δ Taste: medium - sweet
- Δ Shelf life : medium



***Durio graviolens* (Yellow),**  
Year of Durian (2013)

- Δ Size: small
- Δ Flesh: thick
- Δ Flesh Colour: orange
- Δ Odoriness: odorless
- Δ Alkhol content: no alkohol
- Δ Texture : soft, dry
- Δ Water Content: low
- Δ Taste: medium - sweet
- Δ Shelf life : medium



# Aplikasi pemupukan berimbang

- Kontrol: 30 kg pupuk kandang per tanaman
- b. Setengah dosis: 30 kg pupuk kandang per tanaman per tahun + 30 kg Dolomit per tanaman per tahun + 250 kg NPK (15 N 15 P 15 K) per tanaman per tahun + Aplikasi pupuk Mikro (Mn, Cu, Zn, dan Bo) sesuai dosis anjuran kemasan.
- c. Dosis anjuran (Santosa, 2013): 60 kg pupuk kandang per tanaman per tahun + 60 kg Dolomit per tanaman per tahun + 500 kg NPK (15 N 15 P 15 K) per tanaman per tahun + Aplikasi pupuk Mikro (Mn, Cu, Zn, dan Bo) sesuai dosis anjuran kemasan
- d. Over dosis: 90 kg pupuk kandang per tanaman per tahun + 90 kg Dolomit per tanaman per tahun + 750 kg NPK (15 N 15 P 15 K) per tanaman per tahun + Aplikasi pupuk Mikro (Mn, Cu, Zn, dan Bo) sesuai dosis anjuran kemasan



# Sequencing and Diversity analysis are in progress

## Publication

PROS SEM NAS MASY BIODIV INDON  
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ISSN: 2407-8050  
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### Review:

## Aplikasi DNA barcoding untuk analisis keragaman genetik lai-durian (*Durio zibethinus* x *kutejensis*) asal Kalimantan Timur

DNA barcoding application to analyze the genetic diversity of lai-durian (*Durio zibethinus* x *kutejensis*) from East Kalimantan

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Manuskrip diterima: 6 Mei 2015. Revisi disetujui: 6 Juli 2015.

Sunaryo W. 2015. Aplikasi DNA barcoding untuk analisis keragaman genetik lai-durian (*Durio zibethinus* x *kutejensis*) asal Kalimantan Timur. Pros Sem Nas Masy Biodiv Indon 1: 1273-1277. Keragaman buah-buahan lokal di Indonesia mer  
meningkatkan daya saing menghadapi membanjirnya buah-buah import. Lai-durian (*Durio zibethinus* x *kutejensis*)  
hasil silangan alami antara buah durian (*Durio zibethinus*) dan lai (*Durio kutejensis*) adalah buah kha  
mempunyai sifat-sifat unggul dalam hal rasa dan performa buah, sehingga sering memenangkan kontes duria



## Patent

KEMENTERIAN HUKUM DAN HAK ASASI MANUSIA  
REPUBLIK INDONESIA  
DIREKTORAT JENDERAL KEKAYAAN INTELEKTUAL  
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Nomor : HKI.3-HI.05.01.02.S00201708791 Jakarta, 11 Desember 2017  
Lampiran : 1 (satu) berkas  
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Yth. LPPM Universitas Mulawarman  
Jl. Krayan No. 1, Kampus Gr. Kelua, Universitas  
Mulawarman, Samarinda" Kalimantan Timur 75119

Dengan ini diberitahukan bahwa Permohonan Paten:

Tanggal Pengajuan : 07 Desember 2017  
(21) Nomor Permohonan : S00201708791  
(71) Pemohon : LPPM Universitas Mulawarman  
(54) Judul Invensi : KOMPOSISI BUFFER EKSTRAKSI DNA DAUN TANAMAN DURIAN PADA  
METODE EKSTRAKSI TANPA MENGGUNAKAN NITROGEN CAIR DAN  
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(74) Konsultan HKI :  
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