การเจริญเติบโตและผลผลิตของกล้าปาล์มน้ำมันข้ามปีในจังหวัดกระบี่ประเทศไทย
Growth and Yield of Over-year Oil Palm Seedling in Krabi Province, Thailand

สิรินภา คงเจริญ[1] สมคิด ดำน้อย[2] พัชรินทร์ ตัญญะ[1] สุรกิตติ ศรีกุล[2] รพี ดอกไม้เทศ[3] พีระศักดิ์ ศรีนิเวศน์[4] เอนก ลิ่มศรีวิไล[5] และวีระพันธุ์ สรีดอกจันทร์[1*]

Sirinapha Khongcharoen[1], Somkid Damnoi[2], Patcharin Tanya[1], Surakitti Srikul[2], Rapee Dokmaithes[3], Peerasak Srinives[4], Anek Limsrivilai[5] and Weeraphan Sridokchan[1*]

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Abstract: Performance of normal and over-year oil palm seedlings, in terms of the growth traits and yield production, was evaluated using three replications of a split plot in a randomized complete block design. The main plot was comprised of two types of oil palm seedling (normal and over-year), while the subplot contained seven different oil palm hybrids. Growth characteristics was recorded every 6 months from 12 to 60 months after transplanting (MAT), while the yield data was recorded from 31 to 66 MAT. All of the vegetative growth traits showed no significant difference between normal and over-year seedlings. During the first two years of harvesting, there was no significant difference in the fresh fruit bunch (FFB) production between normal and over-year seedlings. However, in the third year of harvesting, normal seedlings showed a significantly higher FFB than over-year seedlings, with yields of 163 and 145 kg/palm, respectively. The bunch number showed no significant difference between the two types of oil palm seedling. The Thai oil palm cultivars (Deli × Yangambi-T and Deli × Tanzania-T hybrids) had the highest 3-year accumulated FFB yield at 326 and 330 kg/palm, respectively. These results suggest that the hybrid oil palm cultivars bred and developed by the Thai companies can produce a FFB yield as high as the imported cultivars.

Keywords: *Elaeis guineensis*, FFB, hybrid, large field plot, over-year seedling

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[1] ภาควิชาพืชไร่นา คณะเกษตร กำแพงแสน มหาวิทยาลัยเกษตรศาสตร์ วิทยาเขตกำแพงแสน จังหวัดนครปฐม 73140

[1] Department of Agronomy, Faculty of Agriculture at Kamphaeng Saen, Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom 73140, Thailand

[2] สาขาวิชาวิจัยและพัฒนาการเกษตร มหาวิทยาลัยเกษตรศาสตร์ วิทยาเขตกำแพงแสน จังหวัดนครปฐม 73140

[2] Agricultural Research and Development, Faculty of Agriculture at Kamphaeng Saen, Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom 73140, Thailand

[3] ภาควิชาส่งเสริมและนิเทศศาสตร์เกษตร คณะเกษตร กำแพงแสน มหาวิทยาลัยเกษตรศาสตร์ วิทยาเขตกำแพงแสน จังหวัดนครปฐม 73140

[3] Department of Agricultural Extension and Communication, Faculty of Agriculture at Kamphaeng Saen, Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom 73140, Thailand

[4] สำนักวิทยาศาสตร์ ราชบัณฑิตยสภา เขตดุสิต กรุงเทพ 10300

[4] Fellow, Academy of Science, The Royal Society of Thailand, Dusit, Bangkok 10300, Thailand

[5] บริษัทโกลเด้นเทเนอร่าจำกัด 12/9 ถ.หน้าพลับพลา ต.กระบี่ใหญ่ อ.เมือง จ.กระบี่ 81000

[5] Goldentenera Company Limited 12/9 Naplubpla Rd., Krabiyai Sub-ditrict, ampur. Muang Krabi Muang District, Krabi 81000

*Corresponding author: agrwps@ku.ac.th

บทคัดย่อ: การทดลองนี้จัดทำขึ้นเพื่อศึกษาสมรรถภาพของกล้าปาล์มน้ำมันปกติและกล้าข้ามปี ต่อลักษณะการเจริญเติบโตและ ผลผลิต ใช้แผนการทดลองแบบ Split Plot in Randomized Complete Block design (RCBD) จำนวน 3 ซ้ำ ปัจจัยหลักคือกล้าปาล์มน้ำมัน 2 ชนิด (ปกติและข้ามปี) ปัจจัยย่อย คือ พันธุ์ปาล์มน้ำมัน 7 ลูกผสม บันทึกข้อมูลการเจริญเติบโตทุก 6 เริ่มที่ 12 ถึง 60 เดือนหลังย้ายปลูก และข้อมูลผลผลิตบันทึกที่ 27 ถึง 63 เดือนหลังย้ายปลูก พบว่าการเจริญเติบโตทางลำต้นและใบทุกลักษณะ ไม่มีความแตกต่างอย่างมีนัยสำคัญระหว่างต้นกล้าปกติและกล้าข้ามปี ในช่วงสองปีแรกของการเก็บเกี่ยว ผลผลิตทะลายสดระหว่างต้นกล้าปกติและต้นกล้าข้ามปีไม่มีความแตกต่างอย่างมีนัยสำคัญ อย่างไรก็ตามในปีที่ 3 ของการเก็บเกี่ยว ต้นกล้าปกติมีผลผลิตทะลายปาล์มสดสูงกว่ากล้าข้ามปีอย่างมีนัยสำคัญ โดยให้ผลผลิต 163 และ 145 กิโลกรัม/ต้น ตามลำดับ ในขณะที่จำนวนทะลายสดพบว่าต้นกล้าปาล์มน้ำมัน 2 ชนิดไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติ ลูกผสม Deli × Yangambi -T และ Deli × Tanzania-T ซึ่งเป็นพันธุ์ ปาล์มน้ำมันของไทยมีผลผลิตทะลายปาล์มสดสะสมสูงสุด 3 ปีอย่างมีนัยสำคัญที่ 326 และ 330 กิโลกรัม/ต้น ตามลำดับ แสดงให้เห็นว่าพันธุ์ปาล์มน้ำมันลูกผสมที่ปรับปรุงและพัฒนาโดยหน่วยงานในประเทศไทย มีศักยภาพในการให้ผลผลิตทะลายสูงทัดเทียมกับพันธุ์ลูกผสมที่นำเข้า

คำสำคัญ: *Elaeis guineensis*, FFB, ลูกผสม, แปลงทดลองขนาดใหญ่, กล้าข้ามปี

INTRODUCTION

Palm oil are edible crops that are also used for the production of oleochemicals and biodiesel. Annual palm oil consumption is approximately 72 million metric tons worldwide and about 2,750 thousand metric tons in Thailand (Statista, 2022). Oil palm cultivation has continuously expanded in the southern part of Thailand. Individual crops have adapted differently to their biodiversity impacts, depending on the cultivation condition (Beaton *et al*., 1990; Tabatabaei *et al*., 2012). The growth and yield potential of oil palm is associated with the climate, soil property and nutrient elements, especially rainfall and evaporation during the planting period (Corley and Tinker, 2016). Seedling transplantation is performed in the rainy season. In Thailand, the preparation of oil palm seedlings is mostly performed by private companies and retail oil palm seedling nurseries. There are often unsold seedlings remaining in the nursery each year, especially during periods of low palm oil prices. Unlike Malaysia and Indonesia, Thailand has a dry season for 4 months per year, whereas Malaysia and Indonesia have rain throughout the year. It is not suitable to transplant the oil palm seedlings into the field in the dry season, and so the unsold seedlings will become over-year seedlings in the next rainy season.

Over-year seedlings are interesting to use for transplanting because they have a higher stem diameter than normal seedlings, which might reduce the level of destruction by rats in the field. The lateral meristem develops specifically in the first 3 years before the stem elongation stage and vegetative growth, which is important for the oil palm. Over-year seedlings must be subjected to leaf and root (diamond cut) cutting to protect the seedling from water stress. Differences in seedling ages affect the growth and yield of oil palm after transplanting. Rethinam *et al*. (2000) found that younger seedlings showed the highest trunk height and diameter as well as leaf area (LA), while the highest reproductive rate was found in older seedlings. Moreover, older seedlings had a higher leaf production rate, produced leaves earlier, and had heavier bunches with a higher fresh fruit bunch (FFB) ratio in the first year of harvesting (Corley and Tinker, 2003). Despite this, there has not been much research on over-year seedlings. The aim of this study was to test the effects of seedling types (normal and over-year seedling) on the growth characteristics and yield in a large field of commercial oil palm cultivars.

METHERIAL AND METHODS

Plant material: Commercial oil palm seedlings (10–12 months old) from seven different cultivars: four cultivars from a Thai company (coded as Deli × AVROS-T, Deli × Yangambi-T, Deli × LaMe-T, and Deli × Tanzania-T) and three cultivars from a foreign company (coded as Deli × Compact-F, Deli × AVROS-F, and Deli × LaMe-F) were separated into the two types of normal seedlings (11 months after emergence; MAE) and over-years seedlings (22 MAE) with poly-bag unchanged in the nursery. Oil palm seedlings were transplanted to the field at a 9.0 × 9.0 × 9.0 m spacing in an equilateral triangle planting in July–August 2013 at a plant density of 142 plants/ha at the Von Bundit Company Limited, Ao Luek district, Krabi province. Over-year seedlings were not fertilized in the dry season and their leaves and roots were cut by the diamond cut technique before transplanting to the experimental field. The field experiment was run for 66 months after transplanting (MAT). Fertilizer and weed control were managed following the Department of Agriculture (Thailand) guideline during the period.

Vegetative data collection: Vegetative growth traits were observed every 6-month-old, including the frond production (FP), petiole cross section (PCS), rachis length (RL), leaflet length (LL), and leaflet width (LW). Measurements and calculation of vegetative traits, the LA and leaf area index (LAI), were made according to the non-destructive methods suggested by Corley and Breure (1988).

Leaf area: The 9th green mature leaf (when the oil palm seedlings were at 18 and 24 MAT) and the 17th green mature leaf (when oil palms were older than 24 MAT) were collected and recorded. The number of leaflets (leaflet; n), the leaf stalks on one-side and spines at the base of the leaf stalk were recorded. The leaflet measurement was performed on three leaflets on each side of the leaf stalk (total six leaflets) and then the LW and LL of each leaflet was recorded. The LA, relative LA (RLA), LAI, and PCS were derived using Eqs. (1) – (4), respectively.

$$LA = RLA \times 0.55 \quad (1),$$

where LA is in cm^2;

$$RLA = 2n \times b \quad (2),$$

where n = leaflet amount on one-side of leaf stalk, b = average (LW × LL);

$$LAI = AD/10000 \quad (3),$$

where: A = total LA and A = ag, (where: g = total leaf number), D = palm per hectare;

$$PCS = width \times depth\ (cm^2) \quad (4).$$

Reproductive (yield) data collection: The oil palm yield starts to be harvested at the age of 31 MAT, and the ripe oil palm bunches are harvested every 15 days. The oil palm bunches were recorded in terms of FFB and bunch number (BNO), and the data were arranged annually, starting from January to December each year. The data were analyzed for the young mature phase, that is from the first to the third year of harvesting starting in January 2016 and continuing to December 2018 (3 years).

Experimental design and data analysis: Split plot in a randomized complete block design with three replications was used. The main plot was the two kinds of oil palm seedlings (normal and over-year), while the subplot was the seven different oil palm hybrids. Sixteen oil palm plants (from 80 plants per subplot) were randomly sampled for collecting the data. The total number of experimental plants analyzed was 3,660 plants, located in 26 hectares of field area. Analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) were computed using the R statistical program.

RESULT AND DISCUSSION

1. Vegetative traits

At 60 MAT, all the measured vegetative growth traits (i.e., FP, PCS, RL, LL, LW, leaflet number (LN), HT, LA, LAI, and diameter of palm trunk [DIAM]) showed no significant difference between the normal and over-year oil palm seedling (Tables 1 and 2). Typically, mature oil palm seedlings that are over 12 months old would experience more impact from transplanting compared to seedlings that are 10–12 months old. However, in this experiment, the roots and leaves of the over-year seedlings were pruned using a diamond cut method to reduce water loss after transplantation. This method is appropriate because the growth of these seedlings is not significantly different from normal seedlings. In Malaysia and Indonesia, it is recommended to use oil palm seedlings of between 10- to 12-months old only to prevent post-transplanting shock and to save time and costs in seedling preparation (Rethinam *et al*., 2000). However, both countries do not face the issue of seedling dormancy due to their year-round rainfall (no dry season), which allows transplanting of oil palm seedlings throughout the year without the need to wait for specific seasons, in contrast to that in Thailand.

The FP and LN were not significantly different in the seven oil palm varieties and showed a similar frond productivity to the experimental oil palm cultivar. The Deli x Compact-F hybrid had the shortest PCS and RL at 20.3 and 395 cm, respectively, while the other hybrids had RL values that were approximately 8–12% higher than Deli x Compact-F (Table 1). The Deli Compact cultivar is bred by the ASD company in Costa Rica and has the distinct characteristics of short fronds and a small canopy size, which allows a higher planting density of oil palm trees. The Deli x Compact-F hybrid is composed of genetic material from the American oil palm species (*E. oleifera*), which has smaller size compared to the common oil palm species (*E. guineensis*) (Barcelos *et al*., 2015). This allows oil palm growers to use a narrower planting distance of 8.0 x 8.0 m to increase the number of palms per hectare (175 palms per hectare), and so is expected to increase the FFB yield by up to 27.3%.

The Deli × Yangambi-T hybrid showed the highest values of four important leaf index traits: RL (451 cm), LL (91.7 cm), LA (5.34 m^2) and LAI (5.19). These four indices are correlated with the plant's direct photosynthetic capacity due to the presence of the large LA and high LAI, which leads to high photosynthetic rates. The Deli x Tanzania-T hybrid also had the highest RL and LW values at 461 cm and 4.43 cm, respectively, (Table 1). Both the Deli × Yangambi-T and Deli × Tanzania-T hybrids had good leaf characteristics, which would likely impact on the quantity and size of future oil palm bunches. The Deli × LaMe-F hybrid showed the highest HT and DIAM values at 81.67 (cm) and 0.82 (m), respectively, (Table 2)

Table 1 Oil palm vegetative characteristics at 60 MAT

Cultivar	FP (number)			PCS (cm^2)			RL (cm)			LL (cm)			LW (cm)		
	Normal	Over-year	Average	Normal	Over-year	Average	Normal	Over-year	Average	Normal	Over-year	Average	Normal	Over-year	Average
Deli × Compact-F	26.5	26.5	26.5	20.5cde	20.0cde	20.3b	393	397	395b	85.8cd	83.2de	84.5c	4.41	4.36	4.39ab
Deli × AVROS-F	27.2	25.9	26.6	20.4cde	20.5cde	20.5b	442	469	455a	92.1ab	89.2abc	90.7ab	4.20	4.14	4.17bc
Deli × LaMe-F	27.6	26.1	26.9	18.9e	20.4cde	19.7b	439	437	438ab	81.8de	89.7abc	85.8bc	4.47	4.09	4.28abc
Deli × AVROS-T	28.3	27.5	27.9	21.3bcd	20.2cde	20.8ab	442	424	433ab	84.4de	78.2e	81.3c	4.18	4.18	4.18bc
Deli×Yangambi-T	27.7	26.8	27.2	22.8ab	19.5de	21.1ab	454	448	451a	94.1a	89.3abc	91.7a	4.30	4.32	4.31abc
Deli × LaMe-T	27.4	25.6	26.5	20.5cde	20.5cde	20.5b	451	457	454a	87.5bcd	85.2cd	86.3bc	4.07	4.18	4.13c
Deli ×Tanzania-T	27.3	26.3	26.8	23.9a	21.9bc	22.9a	449	473	461a	86.2cd	84.7cd	85.4c	4.30	4.56	4.43a
Average	**27.4**	**26.4**		**21.2**	**20.45**		**438.7**	**443.7**		**87.42**	**85.63**		**4.28**	**4.26**	
Seedling kind (A)		ns			ns			ns			ns			ns	
CV (%)		11.36			7.10			7.01			2.86			8.77	
Cultivar (B)		ns			*			**			**			*	
CV (%)		4.77			6.22			4.57			3.48			4.00	
A*B		ns			*			ns			*			ns	

FP, frond production; PCS, petiole cross section; RL, rachis length; LL, leaflet length; LW, leaflet width; ns, not significant. *, ** Significant differences at the $p \leq 0.05$ and $p \leq 0.01$ level, respectively. Means followed by a different letter within the same column are significantly different ($P \leq 0.05$ by DMRT).

Table 2 Oil palm vegetative characteristics at 60 MAT

Cultivar	LN (number)			HT (cm)			LA (m^2)			LAI			DIAM (m)		
	Normal	Over-year	Average	Normal	Over-year	Average	Normal	Over-year	Average	Normal	Over-year	Average	Normal	Over-year	Average
Deli × Compact-F	135	129	132	76.8b	75.5bc	76.16b	4.72	4.37	4.55b	4.47	4.13	4.30b	0.77b	0.76bc	0.77b
Deli × AVROS-F	143	134	138	73.9cd	69.3e	71.60d	5.47	5.20	5.34a	5.41	5.10	5.26a	0.74cd	0.70e	0.72d
Deli × LaMe-F	139	134	137	81.9a	81.4a	81.67a	5.01	4.27	4.64b	4.94	4.06	4.50ab	0.82a	0.81a	0.82a
Deli × AVROS-T	143	133	138	74.7bc	71.9d	73.31cd	5.06	4.53	4.80ab	4.83	4.34	4.59ab	0.75bc	0.72d	0.73cd
Deli×Yangambi-T	144	136	140	75.6bc	75.6bc	75.64bc	5.73	4.95	5.34a	5.68	4.70	5.19a	0.76bc	0.76bc	0.76bc
Deli × LaMe-T	143	134	139	75.1bc	75.3bc	75.21bc	5.07	4.76	4.92ab	4.48	4.44	4.46ab	0.75bc	0.75bc	0.75bc
Deli ×Tanzania-T	137	132	135	74.8bc	77.1b	75.94b	4.96	4.95	4.96ab	4.77	4.85	4.81ab	0.75bc	0.77b	0.76b
Average	**141**	**133**		**76.1**	**75.2**		**5.15**	**4.72**		**4.94**	**4.52**		**0.76**	**0.75**	
Seedling kind (A)		ns			ns			ns			ns			ns	
CV (%)		4.99			2.10			17.29			17.60			2.35	
Cultivar (B)		ns			**			*			**			**	
CV (%)		3.83			1.91			8.79			9.64			2.00	
A*B		ns			*			ns			ns			*	

LN, leaflet number; HT, palm height; LA, leaf area; LAI, leaf area index; DIAM, diameter of palm trunk. *, ** Significant differences at the $p \leq 0.05$ and $p \leq 0.01$ level, respectively. Means followed by a different letter within the same column are significantly different ($P \leq 0.05$ by DMRT).

2. Yield production

Oil palm bunches were collected during the period of 31 to 66 MAT, which spans a total of 3 years. There were no significant differences in the FFB yields between the normal seedlings and over-year seedlings in the first year, second year and the cumulative yield over the 3-year period. However, in the third year, the normal seedlings had a significantly higher FFB yield compared to the over-year seedlings, with yields of 163 and 145 kg/palm, respectively, (Table 3).

For the different oil palm cultivars, the Deli x AVROS-T hybrid had the highest FFB yield in the first year of harvesting at 33.5 kg/palm, while the Deli × Yangambi-T and Deli × Tanzania-T hybrids had the highest FFB yield in the second year at 118 and 117 kg/palm, respectively. Lastly, the Deli × Tanzania-T cultivar had the highest FFB yield in the third year at 180 kg/palm. For the accumulated 3-years yield, the Deli × Yangambi-T and Deli × Tanzania-T hybrids had the highest FFB yields at 326 and 330 kg/palm, respectively, whereas the Deli × Compact-F and Deli × LaMe-F hybrids had the lowest FFB yields throughout the experiment with, for example, 137 and 128 kg/palm, respectively, in the third year (Table 3). Note that the Deli × Compact-F hybrid has a smaller canopy size compared to the other oil palm hybrids. The FFB yield of this hybrid will increase by 27.3% if it is transplanted at a spacing of 8.0 x 8.0 x 8.0 m.

The normal seedlings of the Deli × AVROS-F, Deli × Yangambi-T and Deli × Tanzania-T hybrid cultivars had FFB yields in the third year of harvesting of 168 kg/palm, 190 kg/palm, and 193 kg/palm, respectively. These values are higher than the SIRIM standard yield of 160 kg/palm (Rajanaidu *et al*., 2013). Oil palm trees typically reach full FFB production capacity when they are around 7 years old. However, in this experiment, the oil palm trees were only 5 years old after transplantation. Thus, the selected oil palm cultivars tested in this study are hybrid combinations with a high potential for yielding significant FFB production in the southern region of Thailand.

There was no significant difference in the BNO between the normal seedlings and over-year seedlings throughout the experimental period. For the different oil palm varieties, there were no significant differences in the BNO among the cultivars in the third year of harvesting (Table 4). However, when combining the harvest yields over the three-year period, it was found that the Deli × LaMe-F, Deli × Yangambi-T, and Deli × Tanzania-T hybrids had the highest BNOs, which were statistically significant, at 51.2, 51.9 and 51.4 bunches per palm, respectively, (Table 4). These hybrids tend to have a higher sex ratio compared to others. In oil palm trees, only one inflorescence develops per frond axil, which can either be a male or female inflorescence depending on the genetics and environmental factors, such as temperature, sunlight, water, soil moisture, and the quantity of essential nutrients (Agusta *et al*., 2020). Therefore, oil palm breeding companies will selectively choose male and female parent palms with high sex ratios to produce hybrid seedlings with higher sex ratios according to the genetics of the parents. If the hybrid seedlings have a higher sex ratio, the number of bunches per palm will also increase accordingly. In addition to genetics, environmental factors, such as temperature, sunlight, water, soil moisture and the quantity of essential nutrients required by oil palm trees, also influence the sex ratio. All of these factors contribute to the sex ratio in oil palm trees.

The Deli × Yangambi-T and Deli × Tanzania-T hybrids that had the highest accumulated FFB over the 3 years evaluated are oil palm cultivars that were bred and developed by Thai agencies. Their parental oil palm trees, grown in Thailand (Surat Thani and Krabi provinces) for generations and likely to have undergone some adaptation to the local environment, have the potential to yield higher BNOs compared to the imported oil palm cultivars. The reason behind this could be attributed to the fact that the parental oil palm trees have adapted to the country's geography and climate, and pass on their genetic traits to the offspring. As a result, oil palm seedlings derived from parental varieties grown in the local region exhibit better growth and have the potential for higher yields compared to imported oil palm seedlings. This aligns with findings reported in other plant species (Beaton *et al*., 1990; Tabatabaei *et al*., 2012).

Table 3 Oil palm FFB weight (kg/palm) in the first to third year of harvesting (31–66 MAT)

Cultivar	1st year			2nd year			3rd year			Accumulate 3 years		
	Normal	Over-year	Average	Normal	Over-year	Average	Normal	Over-year	Average	Normal	Over-year	Average
Deli × Compact-F	16.8	19.4	18.1c	87.7cde	83.4de	85.5b	150	125	137c	255	227	2412c
Deli × AVROS-F	31.5	19.3	25.4abc	89.9de	84.3de	87.1b	168	145	156abc	289	249	269bc
Deli × LaMe-F	24.0	13.4	18.7bc	79.8e	98.7b-e	89.3b	135	121	128c	239	233	236c
Deli × AVROS-T	37.9	29.1	33.5a	107bcd	107bcd	107ab	151	158	155abc	297	295	296ab
Deli×Yangambi-T	30.4	31.5	30.9abc	118ab	119ab	118a	190	162	176ab	338	313	326a
Deli × LaMe-T	32.3	22.7	27.5abc	113abc	91.9cde	103ab	153	134	144bc	299	249	274bc
Deli ×Tanzania-T	37.1	27.4	32.2ab	135a	99.2b-e	117a	193	167	180a	365	294	330a
Average	30.0	23.3		104	97.7		163A	145B		297	266	
Seedling kind (A)		ns			ns			*			ns	
CV (%)		101.89			45.74			8.44			28.6	
Cultivar (B)		**			**			**			**	
CV (%)		29.01			13.34			13.29			10.26	
A*B		ns			*			ns			ns	

*, ** Significant differences at the $p \leq 0.05$ and $p \leq 0.01$ level, respectively. Means followed by a different letter within the same column are significantly different ($P \leq 0.05$ by DMRT).

Means with a different capital letter in the same row (seedling kind) are significantly different ($P \leq 0.05$ by DMRT).

Table 4 Oil palm FFB number (number) in the first to third year of harvesting (31–66 MAT)

Hybrid	1st year			2nd year			3rd year			Accumulate 3 years		
	Normal	Over-year	Average	Normal	Over-year	Average	Normal	Over-year	Average	Normal	Over-year	Average
Deli × Compact-F	8.23	9.25	8.74	19.1c-f	16.9def	17.9bc	16.0	14.7	15.4	43.3	40.8	42.1c
Deli × AVROS-F	12.5	7.59	10.0	15.9f	16.8ef	16.4c	17.7	16.0	16.8	46.1	40.8	43.5bc
Deli × LaMe-F	15.1	8.45	11.8	20.6a-e	24.5a	22.5a	17.6	16.1	16.9	53.4	48.9	51.2a
Deli × AVROS-T	13.7	10.4	12.0	17.6def	20.8a-d	19.2abc	16.9	18.2	17.6	48.3	51.3	49.8ab
Deli×Yangambi-T	12.4	11.1	11.7	19.2c-f	23.3ab	21.2ab	18.5	17.6	18.1	50.1	53.9	51.9a

Table 4 (continued).

Cultivar	1st year			2nd year			3rd year			Accumulate 3 years		
	Normal	Over-year	Average	Normal	Over-year	Average	Normal	Over-year	Average	Normal	Over-year	Average
Deli × LaMe-T	14.8	9.41	12.1	21.9abc	19.9b-f	20.9ab	18.1	16.7	17.4	54.9	46.2	50.6ab
Deli ×Tanzania-T	13.3	10.2	11.7	21.7abc	19.6b-f	20.6ab	18.9	18.6	18.7	53.9	48.7	51.4a
Average	**12.9**	**9.48**		**19.4**	**20.2**		**17.7**	**16.8**		**50.0**	**47.3**	
Seedling kind (A)	ns			ns			ns			ns		
CV (%)	115.44			32.67			21.47			37.24		
Cultivar (B)	ns			**			ns			**		
CV (%)	25.58			10.53			12.13			8.86		
A*B	ns			*			ns			ns		

*, ** Significant differences at the p ≤ 0.05 and p ≤ 0.01 level, respectively. Means followed by a different letter within the same column are significantly different (P ≤ 0.05 by DMRT).

.CONCLUSION

In summary, this study proposed investigate the performance of normal and over-year seedling of 7 commercial oil palm cultivars in southern part of Thailand. At 60 MAT, all the measured vegetative growth traits such as frond production (FP), petiole cross section (PCS), rachis length (RL), leaflet length (LL), leaflet width (LW), leaflet number (LN), leaf area (LA) and leaf area index (LAI) showed no significant difference between the normal and over-year seedlings. There was no significant difference in the FFB yield between normal seedlings and over-year seedlings in the first year, second year, and the cumulative yield over the 3-year period. However, in the third year of harvesting, normal seedlings had a significantly higher FFB yield than over-year seedlings. Thus, the normal oil palm seedlings had a higher yield performance than the over-year oil palm seedlings at 5 years after transplantation. The two hybrid oil palm cultivars developed and cultivated by agencies in Thailand (Deli × Yangambi-T, and Deli × Tanzania-T) have the potential to yield a high bunch production comparable to the imported cultivars. Improved genetically modified oil palm cultivars developed in Thailand have shown better potential in leaf growth, yield production, and yield components compared to imported oil palm cultivars.

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