Summary Research Report:
Suståne Organic Fertilizers on Oil Palm Nursery Stock, United Plantation, Malaysia 2010-2011

United Plantations Berhad Research Center,
Jenderata Estate, Teluk Intan
Perak, Malaysia

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Background:
Malaysia is one of the world's leading producers of palm oil as the climate is ideally suited for optimum growth. There are several large palm oil plantations in Malaysia. Suståne Natural Fertilizer, Inc. (aka "Suståne") has a long history of applications and use in Malaysia and several other Southeast Asian nations. While there are many synthetic and several "organic" (both domestic and imported) fertilizers available to the agriculture and horticultural markets in Malaysia and Southeast Asia, Suståne is the only high quality and high performance organic and organic-based fertilizer with a climate and crop-tested history in the region over the past twenty-plus years. Golden Domes, Suståne's Malaysian-based distributor, sought out key palm oil nursery plantations that were amenable and supportive of evaluating alternate fertilizers for their nursery production with onsite research trials..

Because the Malaysian climate is hot year around and receives significant and frequent rainfall, typical highly soluble chemical fertilizers provide only short-term fertility due to rapid volatization (ammonification) and ongoing (nitrate) leaching; requiring frequent and continuous topdressing to replace lost nutrients. Although soluble chemical fertilizers have generally lower material costs, the need for repeated applications to individual growing containers increase labor costs and increase environmental damage potential to surface and ground waters in and adjacent to the palm oil plantations. Consequently most of the modernized and larger palm oil plantations in Malaysia rely heavily on various forms of controlled release (time released) plant nutrition. Industry standard controlled released fertilizers are invariably synthetic (man-made) based nutrients that have basic N, P and K granules coated with a polymer resin. Based on soil temperature and water, nutrients are released by osmotic pressure though the outer polymer-coated membrane. As water is imbibed through the polymer shell's micro pores, nutrients are released (exchanged) into the growing media to feed the plant over time.

By contrast to chemical slow-release plant nutrition, Suståne organic fertilizers are based on aerobically composted organic materials (composted turkey litter). Sustane's 26-week aerobic composting process through the induction of oxygen and water into carbon and nitrogenous litter provides an ideal environment for thermophilic microorganisms to transform water soluble N into organic – or carbon-bound forms of nitrogen, held within the cell walls of the microbial biomass, creating a natural form of slow release plant nutrition. As Suståne fertilizer granules are exposed to water, temperature and indigenous soil microorganisms, the organically bound and non-plant available nitrogen is transformed back into plant available ammonium and nitrate nitrogen (i.e. the "nitrogen cycle") over an extended period of time.

Trial Objective:

The objective of the fertilizer comparison trials at United Plantation was to evaluate the efficacy of Sustâne organic formulations against UP's standard chemical fertilizer regime under standard Malaysian oil palm nursery growing conditions.

Trial Description:

Two separate fertilizer trials were established at United Plantations at UP's Berhad Research Center, Jenderata Estate, Teluk Intan, Perak location in northern Malaysia in cooperation with UP Research Staff, Golden Domes of Kuala Lumpur and Sustâne Natural Fertilizer, Inc., Cannon Falls, Minnesota U.S.A. Field trials were conducted to evaluate the suitability and cost effectiveness of Sustâne slow release fertilizer products on oil palm nurseries in Malaysia. The trials were carried out at United Plantation Nursery located at its Research Center at Jenderata Estate 180 km north of Kuala Lumpur.

The trials were done for a period of 12 months from July 2010 to July 2011. Two separate trials were conducted concurrently, one for the Pre-Nursery (1st Stage Nursery) plants and another for the Main Nursery (2nd Stage Nursery) plants. Separate seedlings and samples were used for the trials. The Controls used in these trials were applied with the standard (and current) fertilization programme of United Plantation (UP). This report summarizes the results from Stage 1 fertilizer trials only.

These tests were conducted with the help of the UP Research Center Agronomist, Mr. Vijiandran and UP field personnel who applied the fertilizers and monitored the growth at the trial plots. UP also supplied the plant materials i.e. seedlings and young plants, while Sustâne Natural Fertilizer, Inc., (Cannon Falls, MN USA) via its Distributor, Golden Domes Sdn Bhd, (Kuala Lumpur, Malaysia) supplied the fertilizers for the trial. Golden Domes personnel also made frequent monthly visits to the nursery site for observation, monitoring the fertilizer application and onsite measurements.

This report outlines the Test Protocol, Procedures, Observations, Results and Conclusions for the first nursery stage trials and provides summary data and related photos.

Stage 1 Trial Pre-Nursery

Materials and Methods

Objective: To evaluate Sustâne fertilizers compared with UP standard fertilization programme on oil palm seedlings at the Pre-Nursery stage.

There were three different fertilizer treatments:

A. Standard Nursery Fertilizer – soluble 18-18-18+3MgO plus unknown type and quantities of foliar fertilizers were also applied throughout the trial.

B. Sustane 8-4-4 at 10 g per bag* applied at 45 days after planting (DAP) and 75 DAP

C. Sustane 4-6-4 at 20 g per bag* applied at 45 days after planting (DAP) and 75 DAP

Number of seedlings used: 100 per replicate

No of replicates: 4

Duration of experiment: 90 days

Parameters Measured:

(i) Seedling Height
(ii) Total No of Leaves
(iii) Dry weight of Leaves and Roots

**bag means seedling grow bag; one seedling per bag.*

The seedlings for this trial were taken from a plot that was planted from seeds (not clone or tissue culture) in January 2011.

Fertilizer Treatments

1. Control Treatment was United Plantations standard fertilizer regime utilizing synthetic 18-18-18+3MgO compound fertilizer.
2. Sustane Organic 8-4-4 applied at 10 grams per plant at 45 days after planting (DAP) and 10 grams again at 75 DAP.
3. Sustane Organic 4-6-4 applied at 20 grams per plant at 45 days after planting (DAP) and 20 grams again at 75 DAP.

The first round of fertilization with Suståne took place 45 DAP. UP researchers did not follow the requested protocol of planting 30 DAP. The explanation given was that they wanted to wait for the 2-leaf growth stage (normally takes 45-60 days after planting) and would not apply any granular fertilizers until then. In addition to supplying granular 18-18-18+3MgO Control (A) also received foliar application (UP Standard) throughout the trial period. Plants fertilized with Suståne organic did not receive supplemental foliar fertilizers. The second application of Suståne, on plots B & C was 75 DAP. (The requested protocol called for the second application of Suståne at 60 DAP).

Based on physical (visual) observation on 31 March 2011, i.e. 3 months after planting, there was no of a difference in appearance between A, B and C plots; hence physical measurements were not taken on this date.

At the conclusion of the trial a destructive test was conducted to determine the growth difference between the trial plots. 5 seedlings from each plot were taken for dry weight analysis on roots and leaves. Seeds were also weighed.

Results and Discussion

Stage 1 Results: November 2010 to June 2011. Results as of June 23, 2011 plot ratings

Treatment	Leaf Number	Leaf Length (cm)	Seedling height (cm)	Collar D1 (cm)	Collar D2 (cm)
Control 18-18-18+3MgO[1]	4.85a	34.8a	43.8a	1.1a	1.0a
Sustane Organic 8-4-4[2]	4.55ab	32.4b	40.1b	1.1a	1.1a
Sustane Organic 4-6-4[3]	4.35b	33.8ab	41.2ab	1.1a	1.1a

NOTE: Values followed by the same letter are not statistically significant in difference.

Control Treatment was United Plantations standard fertilizer regime utilizing synthetic 18-18-18+3MgO compound fertilizer plus foliar application (UP Standard) throughout the trial period. Regrettably and apparently for proprietary reasons, UP staff would not describe or disclose the quantities and frequencies of fertilization of their standard fertilizers. However, based on trial experience with UP in the Stage 2 Trials (data not shown) it is understood that the UP standard chemical fertilizer application significantly exceeded the Suståne treatments in NPK formulation concentration, application dose and repetitive fertilizer applications. In the Stage 2 trials The UP standard treatment provided 200% more nitrogen, 800% more phosphorous, and 600% more potassium than what was supplied by the Sustane 16-4-8 experimental treatments. Despite the substantially greater loading rate of nutrients supplied by the UP standard treatment, there was no statistically significant difference in plant growth by fertilizer treatment in the Stage 2 trial results. [See separate Summary Report, UP Stage 2 Fertilizer Trials.]

The results (Figure 1) of the Dry Matter Evaluation are shown below.

- Leaf Dry Weight: Sustane 4-6-4 (C) had highest value, 11% greater than Control (A).
- Roots Dry Weight: Sustane 4-6-4 (C) was highest (44% greater than Control A); followed by Sustane 8-4-4 (B) (11% greater than Control A); and last was Control (A).
- Seeds Weight: Control (A) highest value, second Sustane 4-6-4 (B) and third Sustane 8-4-4 (C).

As reported, by Mr. Vijiandran of UP, from the total seedlings, there was a culling of 14 seedlings from the UP Control A treatment, only 2 culled seedlings from Suståne B and 9 culled seedlings from Suståne C.

Figure 1. Dry Matter Summary: Leaves and Roots

Dry Matter Evaluation - SUSTAIN - UPB - PRE NURSERY TRIAL

	Leaves	Roots	Total
UPB (A)	6.367	1.614	7.981
Sustain (B)	6.032	1.783	7.815
Sustain (C)	7.052	2.328	9.381

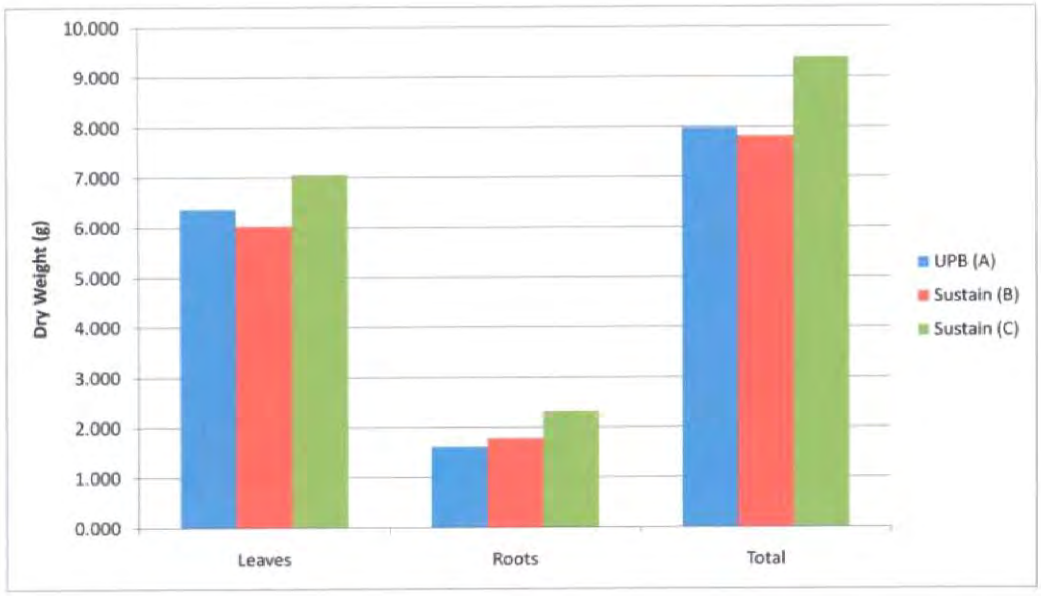

Figure 2. Dry Matter by Replicate: Leaves, Roots and Seeds

Dry Matter Evaluation – Suståne United Plantations – Pre-Nursery Stage 1 Fertilizer Trial

Treatment 18-18-18+3 MgO + F*	Rep	Leaf Dry Weight	Roots Dry Weight	Seeds	Total
UPB (A)	1	7.167	1.893	3.212	12.272
UPB (A)	2	7.048	1.382	4.472	12.902
UPB (A)	3	6.370	1.656	4.868	12.894
UPB (A)	4	5.734	1.530	5.108	12.372
UPB (A)	5	5.514	1.610	3.179	10.303
Total		**31.833**	**8.071**	**20.839**	**60.743**
Mean		**6.367**	**1.614**	**4.168**	**12.149**

Treatment 8-4-4 20 g.	Rep	Leaf Dry Weight	Roots Dry Weight	Seeds	Total
Sustane (B)	1	3.930	1.531	3.562	9.023
Sustane (B)	2	6.625	1.721	3.882	12.228
Sustane (B)	3	6.377	1.923	2.989	11.289
Sustane (B)	4	6.609	1.917	3.721	12.247
Sustane (B)	5	6.620	1.823	1.991	10.434
Total		**30.161**	**8.915**	**16.145**	**55.221**
Mean		**6.032**	**1.783**	**3.229**	**11.044**

Treatment 4-6-4 40 g.	Rep	Leaf Dry Weight	Roots Dry Weight	Seeds	Total
Sustane (C)	1	8.273	2.771	3.022	14.066
Sustane (C)	2	5.795	2.258	2.900	10.953
Sustane (C)	3	4.778	1.280	3.278	9.336
Sustane (C)	4	5.618	2.312	2.321	10.251
Sustane (C)	5	10.798	3.021	1.430	15.249
Total		**35.262**	**11.642**	**12.951**	**59.855**
Mean		**7.052**	**2.328**	**2.590**	**11.971**

*UP 18-18-18+3 MgO also included weekly foliar fertilizer applications. The Suståne plots did not.

Conclusion

The results indicate that Suståne 4-6-4 and 8-4-4 treatments are comparable, if not superior to the UP Standard. According to UP, statistically there was not significant difference between all 3 treatments; however both Suståne treatments outperformed the UP chemical standard fertilizers in both leaf dry matter and total root mass with significantly less total fertilizer applied.

Acknowledgements

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Our valued appreciation for the support given by Suståne, for providing on experimental design protocol, staff time and contribution of fertilizer samples required for the trials.

Pre-Nursery seedlings grown in protected area.

Pre-Nursery trial plots (L-R): A, B, and C January 31, 2011

Seedlings before field transplant
July 15, 2011

Comparison photo all treatments
July 15, 2011

UP Research Team 2011 (L-R):
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Oil Palm Plantation Harvesting
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