

THE BLACK STUFF

Natural Organic Humate | Trial Report

PPC CORN AND CAVENDISH BANANA TRIAL

NSA Organic Fertiliser Effectiveness Study | Vientiane Capital, Lao PDR 2019–2020

01 September 2019 – 30 January 2020 | TBS-TR-LAO-PPC-2019

1. TRIAL OVERVIEW

Trial Reference	TBS-TR-LAO-PPC-2019
Location	Green House, Plant Protection Centre, Ban Nahai, Hat Saifong District, Vientiane Capital, Lao PDR
Supervising Authority	Plant Protection Centre, Department of Agriculture, Ministry of Agriculture & Forestry, Lao PDR
Supervising Researcher	Vilosa Thaliboot, Plant Protection Centre
Crops	Cavendish Banana — <i>Musa acuminata</i> cv. Brazil (tissue-culture seedlings); Field Corn — seedlings
Growing Environment	Controlled greenhouse pot trial; one plant per pot; one pot per replicate
Trial Period	01 September 2019 – 30 January 2020 (5 months; assessments at 30, 60 and 90 days)
Trial Design	Completely Randomised Design (CRD), 4 treatments × 4 replications (16 units per crop)
Statistical Method	ANOVA with Duncan's Multiple Range Test, 95% confidence level ($P < 0.05$), SAS Window 9.1
Product Tested	The Black Stuff (TBS) Humate Soil Conditioner — referred to in the original Lao PDR report as "Soils North NSA Organic Fertilizer"
Treatments	T1 Control (nil); T2 = 1 t/Ha (0.9 kg/pot); T3 = 2 t/Ha (1.8 kg/pot); T4 = 3 t/Ha (2.7 kg/pot)

2. BACKGROUND & RATIONALE

Banana is among the fastest-growing fruiting plants and a primary export crop from Lao PDR to China, Vietnam and Thailand. Cavendish banana is a heavy feeder, requiring substantial nitrogen, phosphorus and potassium inputs to achieve commercial yields. Conventional practice in Lao PDR relies on heavy synthetic fertiliser applications — often in excess — with attendant soil degradation, leaching and cost pressures on smallholder growers.

Published research on Cavendish banana nutrition indicates that nitrogen applied at approximately 170 g/plant promotes foliar growth, fruit size, branch and flower development, and earlier ripening. Phosphorus at 60 g/plant improves hand number per branch, fruit size and flowering. Potassium at 300 g/plant (applied 4–5 months after planting) has been shown to increase bunch weight, fruit count per plant and fruit weight, with overall fruiting efficiency rising by more than 10% and time-to-harvest shortened by approximately 3 months.

Corn (maize) is grown across Lao PDR as a staple and cash crop. It is sensitive to soil fertility and responds strongly to organic matter and balanced nutrition. Both crops present a rigorous test of soil-conditioning products under tropical conditions.

TBS (marketed historically in-country as “NSA Organic Fertilizer”) is a humate-based organic soil conditioner produced from Queensland humate mineral. This trial tested TBS at three application rates against an untreated control to establish its effect on growth parameters and fruiting in banana and corn under controlled greenhouse conditions.

3. OBJECTIVE

To compare the effectiveness of The Black Stuff (TBS) humate soil conditioner, applied at three rates against an untreated control, on the vegetative growth and fruiting of Cavendish banana and corn under controlled greenhouse conditions over a 90-day observation period.

4. TRIAL DESIGN & METHODOLOGY

4.1 Materials

- The Black Stuff (TBS) humate soil conditioner — granular organic product
- Cavendish banana (*Musa acuminata* cv. Brazil) — tissue-culture seedlings, certified disease and pest free
- Field corn seedlings
- Planting pots (growing bowls) — uniform size, one plant per pot
- Standard greenhouse equipment for watering, monitoring and measurement

4.2 Experimental Location

Plant Protection Centre Greenhouse, Ban Nahai, Hat Saifong District, Vientiane Capital, Lao PDR. Controlled temperature and irrigation conditions; uniform greenhouse micro-climate across all treatment units.

4.3 Trial Duration

01 September 2019 to 30 January 2020. Data captured at 30, 60 and 90 days after planting.

4.4 Trial Plan — Completely Randomised Design

A four-treatment, four-replicate Completely Randomised Design (CRD) was used, with one plant per pot and one pot per replicate. Totals: 16 banana units and 16 corn units. Treatments were as follows:

Treatment	TBS Rate (t/Ha)	TBS per Pot	Role
T1 — Control	Nil	Nil	Untreated baseline
T2 — Low	1 t/Ha	0.9 kg/pot	Low-rate TBS
T3 — Mid	2 t/Ha	1.8 kg/pot	Mid-rate TBS
T4 — High	3 t/Ha	2.7 kg/pot	High-rate TBS

4.5 Data Collection

The following parameters were measured at 30, 60 and 90 days after planting:

- Number of leaves — banana and corn
- Plant height (cm)
- Leaf length (cm)
- Leaf width (cm)
- Stem / pseudostem circumference (cm)
- Corn fruit length (cm)
- Corn fruit circumference / diameter (cm)
- Corn fruit weight (g)

4.6 Data Analysis

Statistical analysis was performed using Analysis of Variance (ANOVA) to compare the means between treatments, followed by Duncan's Multiple Range Test at a 95% confidence level ($P < 0.05$). Analyses were conducted using SAS (Statistical Analysis System) Window 9.1. In the results tables that follow, values sharing a common letter (a, b, c, d) are not significantly different from each other at $P < 0.05$.

5. RESULTS

The tables below present mean values per treatment at 30, 60 and 90 days. Letters denote Duncan statistical groupings at $P < 0.05$. CV (%) is the coefficient of variation.

5.1 Number of Leaves

Banana leaf numbers differed significantly between treatments at 30, 60 and 90 days, with TBS at 3 t/Ha producing the highest leaf count at each interval. By 90 days, both T3 and T4 (mid and high TBS rates) reached 10.00 leaves — approximately 82% above the untreated control.

Table 1 — Effect of TBS on banana leaf number (leaves)

Treatment	30 Days	60 Days	90 Days
T1 — Control	6.50 b	5.00 b	5.50 b
T2 — 1 t/Ha	6.75 b	5.75 b	5.50 b
T3 — 2 t/Ha	7.25 b	8.75 a	10.00 a
T4 — 3 t/Ha	8.75 a	9.50 a	10.00 a
CV (%)	9.97	11.61	7.45

Corn leaf numbers differed significantly between treatments at 30 and 60 days. By 60 days, T4 (3 t/Ha) produced 11.25 leaves, almost triple the control at 4.00 leaves.

Table 2 — Effect of TBS on corn leaf number (leaves)

Treatment	30 Days	60 Days
T1 — Control	4.00 c	4.00 c
T2 — 1 t/Ha	4.50 c	7.00 b
T3 — 2 t/Ha	6.50 b	10.75 a
T4 — 3 t/Ha	10.25 a	11.25 a
CV (%)	10.63	23.08

5.2 Plant Height

Banana plant height differed significantly between treatments at all three measurement intervals. At 90 days, TBS treatments T3 and T4 produced plants more than twice the height of the control (103.25–105.25 cm vs 45.00 cm).

Table 3 — Effect of TBS on banana height (cm)

Treatment	30 Days	60 Days	90 Days
T1 — Control	53.00 b	46.75 b	45.00 b
T2 — 1 t/Ha	61.25 b	54.50 b	52.00 b
T3 — 2 t/Ha	70.05 a	71.50 a	103.25 a
T4 — 3 t/Ha	76.50 a	76.75 a	105.25 a
CV (%)	9.09	11.41	12.87

Corn height differed significantly between treatments at 30 and 60 days. At 60 days, T4 plants (134.25 cm) were approximately 6.5 times the height of control plants (20.50 cm).

Table 4 — Effect of TBS on corn height (cm)

Treatment	30 Days	60 Days
T1 — Control	19.50 c	20.50 c
T2 — 1 t/Ha	41.00 b	40.25 b
T3 — 2 t/Ha	57.00 a	129.88 a
T4 — 3 t/Ha	62.63 a	134.25 a
CV (%)	12.23	7.23

5.3 Leaf Length

Banana leaf length differed significantly across treatments at all intervals; at 90 days, TBS at 3 t/Ha produced leaves more than twice the length of control leaves (69.25 cm vs 29.50 cm).

Table 5 — Effect of TBS on banana leaf length (cm)

Treatment	30 Days	60 Days	90 Days
T1 — Control	33.75 c	31.25 c	29.50 c
T2 — 1 t/Ha	37.00 c	36.50 bc	34.25 c
T3 — 2 t/Ha	41.63 b	42.00 b	63.25 b
T4 — 3 t/Ha	45.88 a	53.25 a	69.25 a
CV (%)	6.39	10.76	6.74

Corn leaf length differed significantly between treatments at both 30 and 60 days. At 60 days, T4 leaves reached 79.25 cm — approximately 4.5 times the control length.

Table 6 — Effect of TBS on corn leaf length (cm)

Treatment	30 Days	60 Days
T1 — Control	16.75 c	17.50 d
T2 — 1 t/Ha	38.75 b	39.53 c
T3 — 2 t/Ha	62.63 a	63.63 b
T4 — 3 t/Ha	68.75 a	79.25 a
CV (%)	11.53	9.88

5.4 Leaf Width

Banana leaf width differed significantly between treatments at 30 and 90 days. At 90 days, T4 (3 t/Ha) produced leaves 32.63 cm wide — almost 2.5 times control width.

Table 7 — Effect of TBS on banana leaf width (cm)

Treatment	30 Days	60 Days	90 Days
T1 — Control	16.55 b	16.93	13.13 b
T2 — 1 t/Ha	16.75 b	17.05	15.38 c
T3 — 2 t/Ha	18.88 ab	18.63	30.88 b
T4 — 3 t/Ha	20.38 a	19.63	32.63 a
CV (%)	8.05	10.73	8.44

Corn leaf width differed significantly across all four treatments at both 30 and 60 days, with a clear dose response.

Table 8 — Effect of TBS on corn leaf width (cm)

Treatment	30 Days	60 Days
T1 — Control	1.43 d	1.70 d
T2 — 1 t/Ha	2.85 c	3.20 c
T3 — 2 t/Ha	5.48 b	5.83 b
T4 — 3 t/Ha	6.80 a	8.25 a
CV (%)	8.39	9.69

5.5 Stem / Pseudostem Circumference

Banana pseudostem circumference differed significantly across treatments at all intervals. At 90 days, TBS at 2 and 3 t/Ha approximately doubled pseudostem circumference relative to control (15.25–15.88 cm vs 7.50 cm) — an important structural indicator for subsequent bunch-bearing capacity.

Table 9 — Effect of TBS on banana pseudostem circumference (cm)

Treatment	30 Days	60 Days	90 Days
T1 — Control	7.55 c	7.75 c	7.50 b
T2 — 1 t/Ha	8.00 c	8.00 c	8.38 b
T3 — 2 t/Ha	9.68 b	10.10 b	15.25 a
T4 — 3 t/Ha	10.83 a	11.90 a	15.88 a
CV (%)	5.93	6.26	6.78

Corn stem circumference differed significantly across all four treatments at 30 and 60 days. T4 plants at 60 days achieved stem circumference of 6.83 cm — nearly seven times the control value.

Table 10 — Effect of TBS on corn stem circumference (cm)

Treatment	30 Days	60 Days
T1 — Control	1.13 d	1.00 d
T2 — 1 t/Ha	3.33 c	2.68 c
T3 — 2 t/Ha	5.03 b	4.60 b
T4 — 3 t/Ha	6.25 a	6.83 a
CV (%)	9.09	8.43

5.6 Corn Fruit Length

Corn fruit length at 90 days differed significantly between treatments. Critically, no fruit formed on T1 (Control) or T2 (1 t/Ha) plants. Fruiting occurred only at the 2 and 3 t/Ha TBS rates.

Table 11 — Effect of TBS on corn fruit length at 90 days (cm)

Treatment	90 Days
T1 — Control	0.00 c
T2 — 1 t/Ha	0.00 c
T3 — 2 t/Ha	22.50 b
T4 — 3 t/Ha	24.50 a
CV (%)	8.82

5.7 Corn Fruit Diameter

Corn fruit diameter at 90 days differed significantly between T3 and T4 treatments. As with fruit length, no fruit formed on the control or low-rate lots.

Table 12 — Effect of TBS on corn fruit diameter at 90 days (cm)

Treatment	90 Days
T1 — Control	0.00 c
T2 — 1 t/Ha	0.00 c
T3 — 2 t/Ha	12.50 b
T4 — 3 t/Ha	13.50 a
CV (%)	4.44

5.8 Corn Fruit Weight

Corn fruit weight at 90 days differed significantly between T3 and T4. T4 (3 t/Ha) yielded 114.92 g per fruit, approximately 30% greater than T3 at 88.73 g. No fruit was produced on T1 or T2 lots.

Table 13 — Effect of TBS on corn fruit weight at 90 days (grams)

Treatment	90 Days
T1 — Control	0.00 c
T2 — 1 t/Ha	0.00 c
T3 — 2 t/Ha	88.73 b
T4 — 3 t/Ha	114.92 a
CV (%)	16.78

KEY RESULT — TBS at 3 t/Ha (T4) produced the best growth across every measured parameter in both banana and corn, with highly statistically significant differences over the untreated control ($P < 0.05$). Critically, corn fruit production was entirely dependent on TBS application at 2 t/Ha or greater: the control and low-rate treatments produced zero fruit at 90 days.

FINDING — The dose response across both crops — linear increases in vegetative vigour from T1 through T4 and a sharp fruiting threshold at 2 t/Ha in corn — is consistent with TBS operating as a functional soil amendment rather than a conventional fertiliser. Vegetative and reproductive performance scale with humate loading, consistent with humic-acid-driven improvements to cation exchange, root development and soil biology.

6. SUMMARY OF RESULTS

Across all eight measured growth and fruiting parameters for both crops, Treatment 4 (TBS applied at 3 t/Ha) produced the strongest outcome. Treatment 3 (2 t/Ha) produced the next-best results and was the minimum rate at which corn fruiting occurred. Treatment 2 (1 t/Ha) produced modest gains over control in corn vegetative measures but no fruiting, and did not differ statistically from control in most banana parameters. Treatment 1 (nil control) produced the lowest values across the board, and no corn fruit.

Headline outcomes at 90 days, Treatment 4 (TBS 3 t/Ha):

- Banana — 10.00 leaves; height 105.25 cm; leaf length 69.25 cm; leaf width 32.63 cm; pseudostem circumference 15.88 cm
- Corn — 11.25 leaves; height 134.25 cm; leaf length 79.25 cm; leaf width 8.25 cm; stem circumference 6.83 cm
- Corn fruit (90 days) — length 24.50 cm; diameter 13.50 cm; weight 114.92 g
- T1 and T2 — zero corn fruit produced at 90 days

All between-treatment differences reported above were confirmed at the 95% confidence level ($P < 0.05$) using Duncan's Multiple Range Test.

7. CONCLUSIONS

The PPC controlled-greenhouse trial at the Plant Protection Centre, Vientiane Capital, demonstrates the direct, dose-responsive effect of TBS humate soil conditioner on Cavendish banana and corn under tropical Lao PDR conditions:

- (a) TBS applied at 3 t/Ha (T4) produced the strongest vegetative growth in both crops across every parameter measured — leaf number, plant height, leaf length, leaf width and stem circumference — with statistically significant advantage over the untreated control at $P < 0.05$.
- (b) TBS applied at 2 t/Ha (T3) delivered comparable vegetative performance to T4 in banana at 90 days (leaf number, height, pseudostem circumference), indicating 2 t/Ha represents an effective operating rate with a meaningful cost/performance trade-off against the 3 t/Ha optimum.
- (c) A 2 t/Ha TBS minimum threshold was required for corn fruiting under trial conditions: neither the untreated control (T1) nor 1 t/Ha (T2) produced any fruit at 90 days. T4 at 3 t/Ha yielded fruit of 114.92 g — approximately 30% heavier than T3 fruit.
- (d) The clear, graded dose response across T1 → T4 in both crops is consistent with TBS operating as a humate-driven soil amendment — improving soil structure, biological activity and nutrient availability — rather than as a conventional fertiliser input.
- (e) These results substantiate field-scale application recommendations of 2–3 t/Ha for TBS in tropical banana and corn production systems, and support TBS use in soil-rebuilding programs on degraded or depleted tropical soils.
- (f) Results are consistent with TBS outcomes reported in the parallel Lao PDR rice trials (Wet Season 2019, Dry Season 2020) and the Lao TR1 Sugar Banana and TR4 Cavendish Banana trials (2019–2020), providing a coherent multi-crop evidence base for TBS performance in South-East Asian tropical agriculture.

8. SIGNATORY

Vientiane Capital, 30 January 2020

Vilosa Thaliboot

Researcher, Plant Protection Centre

Department of Agriculture, Ministry of Agriculture & Forestry, Lao PDR

9. CONTACT & FURTHER INFORMATION

Company	The Black Stuff Pty Ltd
Website	theblackstuff.com.au
Contact	info@theblackstuff.com.au 1300 082 011
Trial Reference	TBS-TR-LAO-PPC-2019
Full Report	PPC Corn & Cavendish Banana Trial Scientific Report (2020) available on request

10. APPENDIX — PHOTOGRAPHIC RECORD

The following photographs document plant growth at 30, 60 and 90 days for both banana and corn crops under the trial conditions at the Plant Protection Centre Greenhouse, Vientiane Capital, Lao PDR.

A.1 Day 30 — Establishment



Photo 1 — Corn plants at 30 days (T1–T4)



Photo 2 — Banana plants at 30 days (T1–T4)

A.2 Day 60 — Mid-Trial Vegetative Growth



Photo 3 — Corn plants at 60 days (T1–T4)



Photo 4 — Banana plants at 60 days (T1–T4)

A.3 Day 90 — Final Assessment & Fruiting



Photo 5 — Corn plants at 90 days (fruiting on T3 and T4; no fruit on T1 and T2)

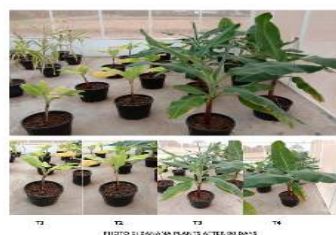


Photo 6 — Banana plants at 90 days (T1–T4)

A.4 Trial Facility



PHOTO 7: GREEN HOUSE, PLANT PROTECTION CENTRE, DEPARTMENT OF AGRICULTURE MINISTRY OF AGRICULTURE & FORESTRY

Photo 7 — Greenhouse, Plant Protection Centre, Department of Agriculture, Ministry of Agriculture & Forestry, Lao PDR