EFFECTS OF SLAG AND VESICULAR ARBUSCULAR MYCORRHIZA (VAM) ON GROWTH AND YIELD OF CANCER BUSH (*SUTHERLANDIA FRUTESCENS*)

**Motlatso Mokwala; Tsobedi Absalom Masenya;
Standford Thosago; Lambert Letsoalo**

Introduction

- Cancer Bush is a valuable indigenous leguminous crop with high demand for medicinal use.
- Synthetic fertilizers are environmental hazards, necessitating natural and sustainable alternatives.
- When compared to inorganic fertilizers, organic fertilizers improve physical, biological and chemical characteristics of soil and plant growth.
- Applying a range of organic fertiliser sources urgently is necessary to reduce the rate at which inorganic fertilisers are utilised (Kakar *et al*., 2020).

Figure 1 Cancer bush (*Sutherlandia frutescens)*

Introduction

- Slag is a mine waste-derived soil amendment
- Vesicular Arbuscular Mycorrhiza (VAM)is a Bio-fertilizer
- The interactive effects of slag and VAM on leguminous crop yields

- The findings of this study will increase knowledge that will improve potential cancer bush domestication using sustainable agricultural practises with the goal of ensuring their availability for medicinal advancement.

Materials and methods

Description of the study location

- The study was conducted at the University of Mpumalanga Nelspruit, South Africa at the university farm (25º 25´ 27” S 30º 58´ 21” E) of Mbombela campus.
- The area receive 876 mm of annual rainfall and an average temperature of 10ºC minimum and 38ºC of maximum.

Materials and methods

Experimental design

- The experiment was arranged as 4 x 4 complete factorial experiment in a randomized complete block design (RCBD) with four slag levels (0, 10, 20 and 30 g) and four VAM levels(0, 10 g, 20 g and 30 g).

- Treatments were replicated three times.

Materials and methods

Slag Analysis

Sample condition: Average
Sub-contractor: None

LAB No.		F22-02858
Your Reference		Slag
Parameter:	**Unit:**	**Results:**
Aluminium as Al	mg/kg	8991
Arsenic as As	mg/kg	11
Boron as B	mg/kg	51
Barium as Ba	mg/kg	183
Calcium as Ca	%	25.88
Cadmium as Cd	mg/kg	0.40
Cobalt as Co	mg/kg	12
Chromium as Cr	mg/kg	9860
Copper as Cu	mg/kg	22
Iron as Fe	%	1.42
Mercury as Hg	mg/kg	<0.10
Potassium as K	mg/kg	13
Magnesium as Mg	%	5.90
Manganese as Mn	mg/kg	4575
Molybdenum as Mo	mg/kg	37
Sodium as Na	mg/kg	964
Nickel as Ni	mg/kg	2213
Phosphorous as P	mg/kg	74
Lead as Pb	mg/kg	8.4
Sulphur as S	mg/kg	1622
Antimony as Sb	mg/kg	<2.0
Selenium as Se	mg/kg	35
Vanadium as V	mg/kg	334
Zinc as Zn	mg/kg	311
Moisture	%	1.6

Materials and methods

Figure 2 Micro plot formation (20cm-20cm spacing)

Figure 3 Sandy loam and hydro mix (3:1)

Materials and methods

Cultural Practices

- Cancer bush seeds were planted directly into 15 cm-diameter plastic pots.
- Treatment was applied by fertigation every 4 days.

Figure 4 Weeding(hand hoes)

Figure 5 Irrigation at 50% saturation (250ml)

Materials and methods

Figure 6 Counting branch number

- Plant height was measured with a ruler.
- Stem diameter measured using a vernier calliper

Figure 8 severed shoot

Figure 7 chlorophyll meter

Figure 9 Shoot weighting with a scale

Materials and methods

Figure 8 Oven drying at 52°C for 72h

Figure 9 Calibrated pH and EC meter

Figure 10 Soil sample collection

Materials and methods

Data analysis

- Data was subjected to Shapiro-Wilk test to determine the normality of distribution of the data (Ghasemi and Zahediasl, 2012; Shapiro and Wilk, 1965), with the data depicting normal distribution.
- Data was then be subjected to analysis of variance using Statistix 10.0 software. Mean sum of squares (MSS) partitioned to establish the total treatment variation (TTV) on each variable (Little, 1981).
- Mean separation was accomplished using LSD test at the probability level of 5%.

Results and discussions

Table 1: Source of variation affecting the shoot dry weight of cancer bush plant at 60 days after initiation of treatment application under micro plot conditions.

		Shoot dry weight	
Source	DF	MS	TTV
Reps	2	0,02	5,26^{ns}
Slag	3	0,15	39,47***
Vam	3	0,04	10,53^{ns}
Slag*Vam	9	0,12	31,58***
Error	30	0,05	13,16^{ns}
Total	47	0,38	100

*** Highly significant at P ≤ 0.05, ns= not significant, TTV (%) = Total Treatment Variation

Results and discussions

Table 2: The effect slag on shoot dry weight of cancer bush plant at 60 days after initiation of treatment application under micro-plot conditions.

Treatment levels Slag (g)	Shoot dry weight(g)	RI %
0	0,4825[a]	0
10	0,2475[b]	-49
20	0,2600[b]	-46
30	0,2733[b]	-43
Relative impact (RI %) = [(treatment/control) – 1] × 100		

[y]Column means ± standard error followed by the same letter were not different ($P \leq 0.05$) according to Fisher's Least Significant Different test. [z]Relative impact (RI %) = [(treatment/control) – 1] × 100.

Results and discussions

Table 3: The effect slag and Vam on shoot dry weight of cancer bush plant at 60 days after initiation of treatment application under micro-plot conditions.

Treatment levels		Shoot dry weight(g)	RI %
Slag(g)	Vam(g)		
0	0	0,2867^{ab}	0
0	10	0,9067^{a}	216
0	20	0,2700^{ab}	-6
0	30	0,4667^{ab}	63
10	0	0,5167^{ab}	80
10	10	0,1533^{b}	-47
10	20	0,1567^{b}	-45
10	30	0,1633^{b}	-43
20	0	0,1300^{b}	-55
20	10	0,2467^{ab}	-14
20	20	0,3400^{ab}	19
20	30	0,3233^{ab}	13
30	0	0,2767^{ab}	-3
30	10	0,2700^{ab}	-6
30	20	0,2800^{ab}	-2
30	30	0,2667^{ab}	-7

Relative impact (RI %) = [(treatment/control) — 1] × 100

Results and discussions

Table 4: Source of variation affecting the soil pH of cancer bush plant at 60 days after initiation of treatment application under micro plot conditions.

		pH	
Source	DF	MS	TTV
Reps	2	0,29	23,96^{ns}
Slag	3	0,58	47,93***
Vam	3	0,09	7,44^{ns}
Slag*Vam	9	0,17	14,05^{ns}
Error	30	0,08	6,61^{ns}
Total	47	1,21	100

*** Highly significant at $P \leq 0.05$, ns= not significant, TTV (%) = Total Treatment Variation

Results and discussions

Table 5: The effect slag on soil pH of cancer bush plant at 60 days after initiation of treatment application under micro-plot conditions.

Treatment levels Slag (g)	pH	RI %
0	6,7350[a]	0
10	6,8408[a]	2
20	7,1733[a]	6
30	7,1517[a]	7
Relative impact (RI %) = [(treatment/control) – 1] × 100		

Conclusions and recommendations

- Slag and VAM enhance cancer bush growth.
- Hypothesis accepted.
- Applying 20g*20g of Slag and VAM significantly boosts growth.
- Slag raises soil pH, an eco-friendly alternative to lime.
- Shifting from chemical to biofertilizers like slag and VAM is a promising strategy for both cost savings and sustainable agriculture.
- However , validation of this study on different seasons is recommended.

References

- Shaphiro, S. and Wilk, M.B.J.B., (1965). An analysis of variance test for normality. Biometrika, 52(3), pp.591-611.
- Ghasemi, A. and Zahediasl, S., (2012). Normality tests for statistical analysis: a guide for non-statisticians. International journal of endocrinology and metabolism, 10(2), p.486.
- Kakar K, Xuan TD, Noori Z, Aryan S, Gulab G,(2020) .Effects of organic and inorganic fertilizer application on growth, yield, and grain quality of rice, Agriculture,10(11),p.544.
- O'Connor J, Nguyen TBT, Honeyands T, Monaghan B, O'Dea D, Rinklebe J, Vinu A, Hoang SA, Singh G, Kirkham MB, Bolan N (2021). Production, characterisation, utilisation, and beneficial soil application of Steel slag: A review, Journal of Hazardous Materials, 419, p. 126478.

Thank you for your attention!

Motlatso Mokwala

Mobil: 0799508382

E-mail:219016305@ump.ac.za

Address: Cnr R40 and D725 Roads,
Mbombela, 1200
South Africa