

Effect of integrating organic with inorganic fertilizers on bean yield on three contrasting soils

By

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Introduction

- Common beans (*Phaseolus vulgaris* L.) are consumed at 57 kg per person annually in Uganda
- Provide 45% of the protein requirement to the local people diets
- Unfortunately, yield gap of 1400 kg ha⁻¹ is majorly due to pests & diseases, and declining soil fertility
- Soil contribute 30% of the gap mostly N and P
- Recommended optimum N and P are above the available 5-10 kg
- 5.0 t manure ha⁻¹ is high
- Non specific to soils and limited N, P, and manure combined recommendations: Phaeozem, Umbrisol, and Cambisol

Main objective

- Develop integrated soil fertility management (ISFM) options for bean production in Masaka district, Uganda

Specific objective

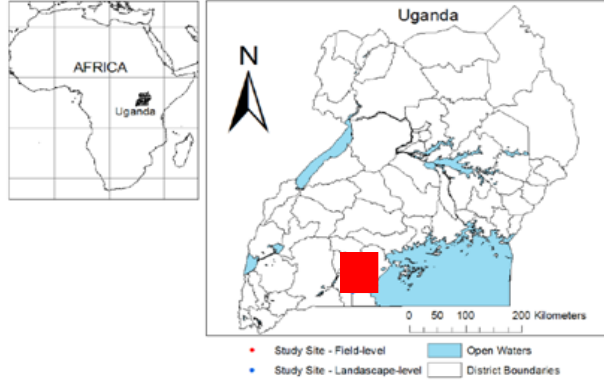
- Establish suitable fertilizer (N, P) and chicken manure application for bean production on three bean soils of Masaka district

Hypothesis

- Combined application of chicken manure with inorganic fertilizer gives at least 30% higher bean grain yield compared to either chicken manure or inorganic fertilizer applied separately

Material and Methods

- Field experiment location



- RCBD split plot; applied N and P each at 0, 7.5, 15 kg ha⁻¹, and manure (0, 2.5, and 5 t ha⁻¹) applied on each soil (main block)



- K131 bean variety
- Plot size 3 m x 2 m
- Spacing 0.5 m x 0.15 m

Yield and its parameters

- Effective nodule (counts)
- Number of pods (counts)
- Seeds per pod (counts)
- Grain yield (kg ha⁻¹)

Data Analysis

- ANOVA using GenStat 12.1
- Fisher's Protected LSD at 5% to separate means
- Descriptive statistics eg %

- Soil and manure chemical properties

Soil type	Soil property						
	pH	OM '-----%-----'	N	P	Ca	Mg '----- (ppm)-----'	K
Phaeozem	5.8	8.18	0.35	8.53	22039	645.6	217.6
Cambisol	5.4	5.89	0.29	13.11	3743	1048.6	191.9
Umbrisol	5.9	8.72	0.40	109.09	1045	262.4	89.4

Manure

pH	OM '-----%-----'	N	P	Ca	Mg	K
7.2	22.44	1.43	0.097	3.31	0.68	0.38

Results

• Effective nodulation

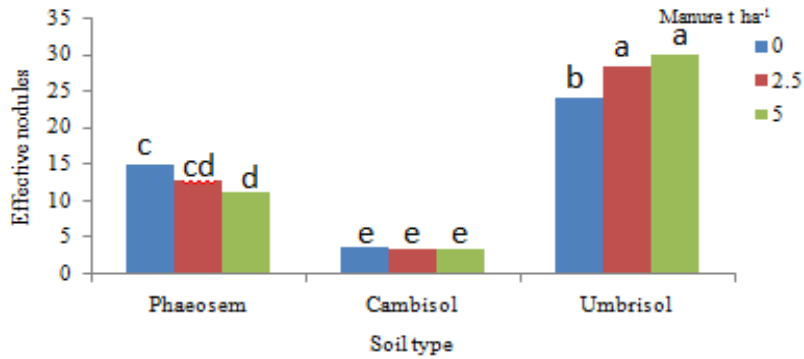


Figure 1: Effect of soils and manure on effective nodulation

• Seeds per pod

Table 1: Effect of manure and N on the number of seeds per pod⁻¹

Soil type	N	Manure (t ha ⁻¹)		
		0	2.5	5
Phaeozem	0	6.8 ^{abcde}	6.9 ^{abcde}	6.9 ^{abc}
	7.5	6.9 ^{abcde}	6.9 ^{abcde}	6.9 ^{ab}
	15	7.1 ^a	6.9 ^{abcd}	6.8 ^{abcde}
Cambisol	0	6.3 ^{hij}	6.3 ^{ij}	6.5 ^{ghij}
	7.5	6.6 ^{cdefg}	6.3 ^{hij}	6.2 ^j
	15	6.2 ^{ij}	6.5 ^{fghi}	6.5 ^{fghi}
Umbrisol	0	6.7 ^{bcdefg}	6.6 ^{cdefg}	6.8 ^{bcdef}
	7.5	6.5 ^{fghi}	6.7 ^{bcdefg}	6.6 ^{defg}
	15	6.7 ^{bcdefg}	6.7 ^{bcdefg}	6.6 ^{efgh}
LSD		0.28		
CV		4.6		

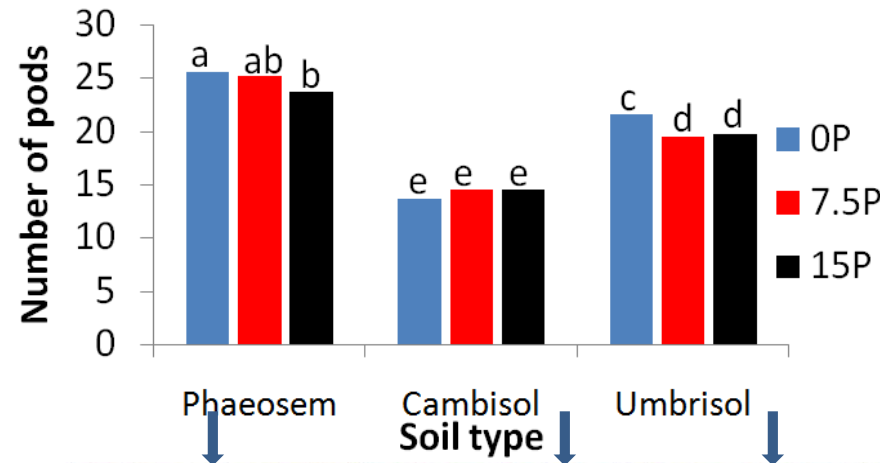


Figure 2: Effect of P application on the number of pods



Grain yield

Table 3: Interactive effect of soils, N, P, and manure on common bean grain yield

		Phaeozem			Cambisol			Umbrisol		
		Manure (t ha ⁻¹)			Manure (t ha ⁻¹)			Manure (t ha ⁻¹)		
		0	2.5	5	0	2.5	5	0	2.5	5
N	P	Grain yield kg ha ⁻¹			Grain yield kg ha ⁻¹			Grain yield kg ha ⁻¹		
0	0	1984.6	2351.5	2129.8	1603.6	1722.9	1942.7	1824.3	2260.8	2851.7
	7.5	2068.9	2075.3	2280.1	1438.6	2101.7	1945.1	2425.9	2224.1	2296.8
	15	2340.8	2415.3	2384.6	1410.8	1881.7	2065	1919.1	2152.6	2299.1
7.5	0	2081.6	2427.7	2557.1	1697	1894.5	2096.3	2126.3	2098.4	2180
	7.5	2116.6	2497.5	2517.8	1529.8	1640.1	1940.2	1872.4	2240	2296.6
	15	2080.4	2483.4	2558.3	1702.2	1761.2	1839.2	1948.1	2547.4	2106.7
15	0	2104.4	2270.3	2477.7	1479.6	1515.6	2312.1	2417.3	2492	2051
	7.5	2094	2236.5	2534.2	1547.8	1946.8	1833.5	2264.4	2246.9	2298.5
	15	2011.8	2463.1	2149.8	1677.1	2083.1	1706.2	1964.2	2055.6	2600.9
LSD					551.7					
CV					16.3					

Grain yield

• Season one

Season two

Table 2: Effect of soils, N, P, and manure on grain yield

Soil type	N	P	Manure (t ha ⁻¹)		
			0	2.5	5
Phaeozem	0	0	2019.7	2460.1	2156.3
		7.5	1743.7	2289.4	2518.9
		15	2202.4	2734.3	2896.8
	7.5	0	2128.4	2683.2	2749.8
		7.5	1752.7	2896.4	2393.6
		15	2051.2	2871.6	2991.9
	15	0	2070.2	2732.9	2849.9
		7.5	2035.6	2809.7	2724.8
		15	1896.5	2939.6	2379.1
Cambisol	0	0	2079.9	2286.5	2306.8
		7.5	1488.1	2406.8	2091.8
		15	1739.4	1973.6	2243.3
	7.5	0	2191	2300.4	2071.5
		7.5	1921.3	1984.3	2350.1
		15	1580.3	2019.1	1909.5
	15	0	1925.5	1906.7	2493.4
		7.5	1736.1	1468	1914.1
		15	1902.8	2775.1	2020.5
Umbrisol	0	0	2052.3	2989.3	3484.6
		7.5	2941.7	2641.8	2474.6
		15	2343.8	2442	2671.3
	7.5	0	2729.2	2494.8	2683
		7.5	2445.6	2634.7	2865.8
		15	2176.2	3339.6	2714.9
	15	0	3128.4	2679	2664.5
		7.5	2609.9	2700.3	2784.7
		15	2246.7	2179.8	3351.7
LSD			787.4		
CV (%)			20.4		

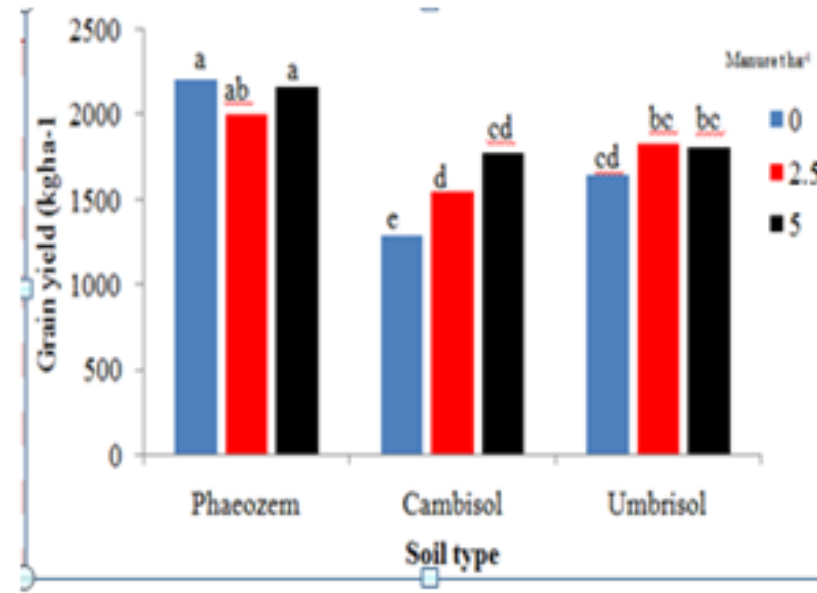


Figure 3: Effect of soil and manure on grain yield

- Manure application significant among soils
- 2.5 t manure ha⁻¹ even in combination significant from the control

Bean grain yield

Table 4: Percentage difference in yield due to amendments

Phaeozem	Contro	Manur	N/P	N+P	N+P+Man
Control	0.0				
Manure	11.4	0.0	4.1	7.4	
N/P alone	7.6		0.0	3.4	
N+P	4.4			0.0	
N+P+Man	17.2	6.5	10.3	13.4	0.0



Cambisol	Contro	Manur	N/P	N+P	N+P+Man
Control	0.0		6.1		
Manur	12.5	0.0	17.8	11.9	
N/P alone	-6.4		0.0		
N+P	0.7		6.7	0.0	
N+P+Man	16.0	4.0	21.1	15.5	0.0



Umbrisol	Control	Manur	N/P	N+P	N+P+Man
Control	0.0				
Manur	28.6	0.0	13.1	21.3	11.5
N/P alone	17.9		0.0	9.4	
N+P	9.3			0.0	
N+P+Man	19.3	-13.0	1.7	11.0	0.0



CONCLUSION

- ❑ Combined application of organic and inorganic gives higher grain yield than inorganic or organic applied separately
- ❑ Soil specific recommendations are more important
 - ✓ Phaeozems: Application of $7.5 \text{ kg N ha}^{-1} + 15 \text{ Kg P ha}^{-1} + 5 \text{ t manure ha}^{-1}$ gave 2558 kg ha^{-1} vs 1984 kg ha^{-1} for control
 - ✓ Umbrisol: Application of $5 \text{ t manure ha}^{-1}$ alone gave 2851 kg ha^{-1} vs 1824 kg ha^{-1} for control
 - ✓ Cambisol: Application of $15 \text{ kg N ha}^{-1} + 0 \text{ Kg P ha}^{-1} + 5 \text{ t manure kg N ha}^{-1}$ gave 2312 Kg ha^{-1} vs 1603 kg ha^{-1} for control
- ❑ Combined application of N+P+manure though significantly increases grain yield higher than N/and P combination, it is not sufficient to solve the 30% yield gap caused by soil fertility decline

Acknowledgement

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THANK YOU