

Table S1: Weather Data of Experimental Site for 2021 and 2022 Cropping Seasons at Nyankpala, Ghana

Month	Mean Monthly Rainfall (mm)		Mean Monthly Temperature (°C)		Mean Monthly Relative Humidity (%)	
	2021	2022	2021	2022	2021	2022
January	0.0	0.0	29.0	27.4	34.2	37.1
February	0.0	0.0	29.7	30.7	25.7	41.2
March	18.5	0.9	32.7	32.4	30.9	58.1
April	25.5	5.8	32.6	29.9	29.9	72.0
May	12.0	3.2	30.2	29.1	32.9	76.4
June	20.4	5.1	28.6	28.0	38.1	82.5
July	8.5	5.1	27.0	26.6	44.8	88.2
August	16.0	11.4	26.9	25.9	46.2	85.3
September	12.3	9.3	27.0	26.2	46.3	84.0
October	8.5	2.1	28.4	27.5	46.1	84.7
November	18.1	0.0	29.4	28.6	44.5	78.3
December	0.0	0.0	28.2	27.6	30.7	76.4

Table S2: Profitability for Cowpea Production at Different OFA application - VCR

Year	2021			2022			Mean yield (2021&2022)		
	Treatments			Treatments			Treatments		
	Control	Foliar Application	Soil Drenching	Control	Foliar Application	Soil Drenching	Control	Foliar Application	Soil Drenching
<b>Gross Income (per ha)</b>									
Average Yield (kg)	873	1120	1265	854	1114	1416	863	1117	1341
Adjusted Yield (kg) @10%	785.7	1008	1138.5	768.6	1002.6	1274.4	776.7	1005.3	1206.9
Price (US \$ /kg)	1.24	1.24	1.24	1.45	1.45	1.45	1.35	1.35	1.35
<b>Gross Revenue (US \$)</b>	<b>978.05</b>	<b>1254.77</b>	<b>1417.22</b>	<b>1116.22</b>	<b>1456.06</b>	<b>1850.79</b>	<b>1047.42</b>	<b>1355.70</b>	<b>1627.56</b>
<b>Variable Cost items (US \$/ha)</b>									
Seed cost	34.58	34.58	34.58	34.58	34.58	34.58	34.58	34.58	34.58
Ploughing cost	27.66	27.66	27.66	41.49	41.49	34.58	34.58	34.58	34.58
Planting Cost	34.58	34.58	34.58	41.49	41.49	41.49	38.04	38.04	38.04
Weeding Cost	34.58	34.58	34.58	48.41	48.41	48.41	41.49	41.49	41.49
OFA Application	0.00	20.75	29.05	0.00	20.75	30.43	0.00	20.75	29.74
Pest control	27.66	27.66	27.66	33.20	33.20	33.20	30.43	30.43	30.43
Harvesting cost	34.58	34.58	34.58	48.41	48.41	48.41	41.49	41.49	41.49
Post Harvesting Cost	27.66	27.66	27.66	31.12	31.12	31.12	29.39	29.39	29.39
Insecticides Cost	44.26	44.26	44.26	52.56	52.56	52.56	48.41	48.41	48.41
Cost of OFA	0.00	7.61	11.41	0.00	7.61	11.41	0.00	7.61	11.41
Transportation(carting)	20.75	20.75	20.75	27.66	27.66	27.66	24.20	24.20	24.20
<b>Total Variable Cost</b>	<b>286.31</b>	<b>314.66</b>	<b>326.76</b>	<b>358.92</b>	<b>387.28</b>	<b>400.76</b>	<b>322.61</b>	<b>350.97</b>	<b>363.76</b>
<b>Total Fixed Cost (US \$)</b>	138.31	138.31	138.31	138.31	138.31	138.31	138.31	138.31	138.31
<b>Total Cost (US \$)</b>	<b>424.62</b>	<b>452.97</b>	<b>465.08</b>	<b>497.23</b>	<b>525.59</b>	<b>539.07</b>	<b>460.93</b>	<b>489.28</b>	<b>502.07</b>
<b>Net Profit (US \$/ha)</b>	<b>553.43</b>	<b>801.80</b>	<b>924.48</b>	<b>618.99</b>	<b>930.47</b>	<b>1311.72</b>	<b>586.49</b>	<b>866.41</b>	<b>1125.49</b>
<b>Value: Cost Ratio (VCR)</b>	<b>1.3</b>	<b>1.77</b>	<b>2.05</b>	<b>1.24</b>	<b>1.77</b>	<b>2.43</b>	<b>1.27</b>	<b>1.77</b>	<b>2.24</b>

Note: US \$1 = GH¢7.23 (Bank of Ghana, 2022). Control is the farmer Practice

Table S3: Pearson's Correlation Coefficients for on Cowpea Productivity Parameters and Soil Health Indicators

Parameters	Shoot DM	Root DM	Nodule Mass	Pod Yield	Grain Yield	Stover Yield	PHI	HI	Soil pH	APHASE	ADASE	ASHASE	DHASE	GMEA	POXC	Av. P	A. N	MBN	PMN	Cum._Evol. CO2
Root DM	0.649*																			
Nodule Mass	0.776*	0.552 ns																		
Pod Yield	0.846*	0.469 ns	0.822*																	
Grain Yield	0.727*	0.251 ns	0.645*	0.943*																
Stover Yield	0.535 ns	0.694*	0.628*	0.344 ns	0.065 ns															
PHI	0.398 ns	0.024 ns	0.436 ns	0.566 ns	0.582 *	0.269 ns														
HI	0.226 ns	-0.310 ns	0.020 ns	0.507 ns	0.708*	-0.508 ns	0.317 ns													
Soil pH	0.543 ns	0.164 ns	0.478 ns	0.433 ns	0.478 ns	0.169 ns	0.355 ns	0.079 ns												
APHASE	0.675*	0.212 ns	0.812*	0.867*	0.841*	0.216 ns	0.345 ns	0.468 ns	0.545 ns											
ADASE	0.696 *	0.394 ns	0.831 *	0.765*	0.581*	0.588*	0.354 ns	0.133 ns	0.297 ns	0.803*										
ASHASE	0.633*	0.211 ns	0.730 *	0.807 *	0.820*	0.221 ns	0.308 ns	0.435 ns	0.528 ns	0.941 *	0.705 *									
DHASE	0.601*	0.026 ns	0.330 ns	0.645 *	0.714 *	0.138 ns	0.697 *	0.576*	0.283 ns	0.433 ns	0.347 ns	0.483 ns								
GMEA	0.766 *	0.259 ns	0.810 *	0.907 *	0.866*	0.345 ns	0.472 ns	0.460 ns	0.499 ns	0.953 *	0.852*	0.938 *	0.631*							
POXC	0.229 ns	-0.126 ns	0.140 ns	0.538 ns	0.755*	-0.536 *	0.157 ns	0.842 *	0.254 *	0.572 *	0.085 ns	0.603*	0.400 ns	0.491 ns						
A._P	0.275 ns	0.371 ns	0.470 ns	0.296 ns	0.138 ns	0.627 ns	-0.114 ns	-0.214 ns	0.024 ns	0.408 ns	0.473 ns	0.495 ns	0.059 ns	0.441 ns	-0.134 ns					
A. N	-0.646 *	-0.761 *	-0.802 *	-0.760 *	-0.568 *	-0.641*	-0.273 ns	0.016 ns	-0.112 ns	-0.611*	-0.718 *	-0.606 *	-0.211 ns	-0.645 ns	-0.137 ns	-0.597 *				
MBN	0.589 *	0.154 ns	0.577*	0.872*	0.934*	-0.075 ns	0.574 ns	0.716*	0.412 ns	0.781*	0.536 ns	0.678 *	0.614 *	0.761*	0.763*	-0.058 ns	-0.458 ns			
PMN	-0.676*	-0.784*	-0.785*	-0.669*	-0.433 ns	-0.748 *	-0.286 ns	0.174 ns	-0.093 ns	-0.490 ns	-0.739 *	-0.462 ns	-0.287 ns	-0.585*	0.051 ns	-0.465 ns	0.860 *	-0.400 *		
Cum._Evol. CO2	0.653*	0.575*	0.677*	0.571*	0.312 ns	0.862*	0.491 ns	-0.173 ns	0.126 ns	0.368 ns	0.760 *	0.278 ns	0.373 ns	0.516 ns	-0.361 ns	0.475 ns	-0.689 *	0.225 ns	-0.744 *	
Cum._Min. C	0.565 ns	0.337 ns	0.590 *	0.580 *	0.364 ns	0.665*	0.504 ns	0.091 ns	-0.025 ns	0.406 ns	0.753*	0.258 ns	0.478 ns	0.542 ns	-0.221 ns	0.392 ns	-0.540 ns	0.348 ns	-0.635*	0.722*

Note: Values with (\*) starlike symbols indicate different at significance at  $p = 0.05$ . ns = not significantly different at  $p = 0.05$  Pod\_Yield = pod yield; Grain\_Yield = grain yield; Nodule\_Mass = nodule mass; GMEA = geometric mean enzyme activity; ASHASE= arylsulphatase; DHASE =dehydrogenase, APHASE = acid phosphatase; ADASE = alpha glucosidase; Soil\_pH = soil pH; POXC = permanganate oxidizable C; PHI = pod harvest index; HI = harvest

index; Stover\_Yield = Stover yield; Root\_DM = Root dry matter; Av P = available phosphorus, Cumu\_Evolv\_CO2 = cumulative evolved CO2; Cumu\_Min. C = Cumulative mineralizable C; AV\_P = available phosphorus. Microbial biomass nitrogen, A\_N = available N (NH4+-N+NO3--N); PMN = potentially mineralizable N. The plant parameters used for Pearson correlation were means of two-years.