

Original Research Article

Evaluation of grain yield of two varieties of Cowpea (*Vigna unguiculata*) subjected to four agricultural practices in Gùrué District, Mozambique

ABSTRACT

To evaluate the effect of four agricultural practices in grain yield, two varieties (IT 16 and IT- 18) of cowpeas were installed in the agricultural year 2016/2017 an experimental field where the following agricultural practices were tested: tillage, tillage + mulch, zero tillage and zero tillage + mulch. The Randomized Complete Blocks Design, a scheme consisting of two factors: agronomic practices and varieties was used. The plant height, number of pods per plant, weight of 100 seeds and grain yield in kgha-1 were considered as parameters for analysis. The data collected from the field were statistically analyzed by ANOVA test, and the statistically different results were submitted to Tukey test at 5 % significance for comparison of their means. From the results, it was concluded that for the yield of grain of different varieties under study, the variety IT- 18 subjected to zero tillage + mulch and the variety IT- 16 subjected to tillage had better performance achieving 2600.00 kgha-1 and 1725.00 kgha-1 respectively; therefore, recommended to the farmers.

Keywords: Agricultural practices, cowpea (*Vigna unguiculata*), grain yield, varieties, Gùrué.

1. INTRODUCTION

Nowadays, supplying the crescent worldwide population index with adequate food, when people are getting low grain yields, with food scarcity and additional nutrients becoming one of the major factors facing the challenges of food security, is the major focus in the field of agriculture (Olusanya et al. 2016). For instance, there are different agronomic practices with great effect on the quality of the harvested crops (Putnam, Orloff, and Ackerly 2000).

The most known agronomic practices are the tillage, zero tillage and mulch. While tillage is a system of managing crop residue on the soil surface with minimum or no tillage (Unger and McCalla 1980); the zero tillage is conceptualized as a tillage system in which soil disturbance is reduced to sowing operations and traffic only, and where weed control must be achieved by chemical means involving higher water content in the top soil layer, reduced soil aeration, stronger mechanical resistance to root penetration, smaller soil temperature amplitudes, and a different pattern of nutrient distribution in the soil profile (Baeumer and Bakermans 1973).

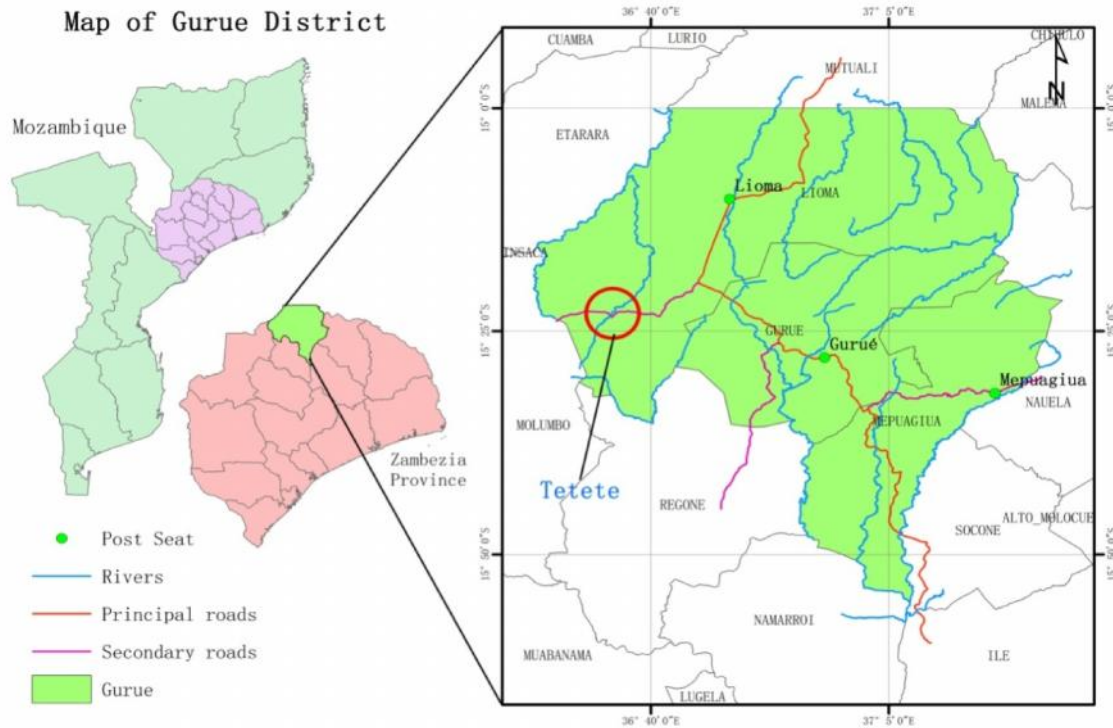
34 The mulch systems offers a great agro-ecological potential providing innumerous services such
35 as water conservation, enhancement of crop yield and improvement of the soil ecology
36 (Erenstein 2003). It conserves the humidity in the soil, thus increasing the yield of crops by
37 about 20% (Maduakor, Lal, and Opara-Nadi 1984).

38 Apart from the climatic conditions and soil ecology, the yield of many crops is also seriously
39 affected by the agronomic practices, varieties utilized and the application or not of fertilizers.
40 For the farmers who experience challenges of using fertilizers due to the costs, the usage of
41 varieties which have the capacity of fixing Nitrogen into the soil such as Soybean (*Glycine max*)
42 and Cowpea, is the better alternative. The Cowpea, scientifically known as *Vigna unguiculata*
43 (Haruna and Usman 2013), is an annual legume originated in Africa and widely expanded to
44 Asia and America (Iruhvwu 2015). In fact, in the selected study area, this crop is farmed by small
45 scale farmers for subsistence and for research activities by local research companies. Many
46 studies are being developed to increase the actual yield acquired by the small-scale farmers,
47 which has been reported to be less than 100kg ha^{-1} . The National average is at 250kg ha^{-1}
48 (Walker and Cunguara 2016).

49 This study aimed to evaluate the grain yield of 2 (two) varieties of cowpea subjected to 4 (four)
50 agricultural practices (Tillage, Zero Tillage, Tillage + Mulch and Zero Tillage + Mulch), so as to
51 recommend the best agronomic practice with the ability to produce a better grain yield in
52 Cowpea varieties.

53 2. MATERIAL AND METHODS

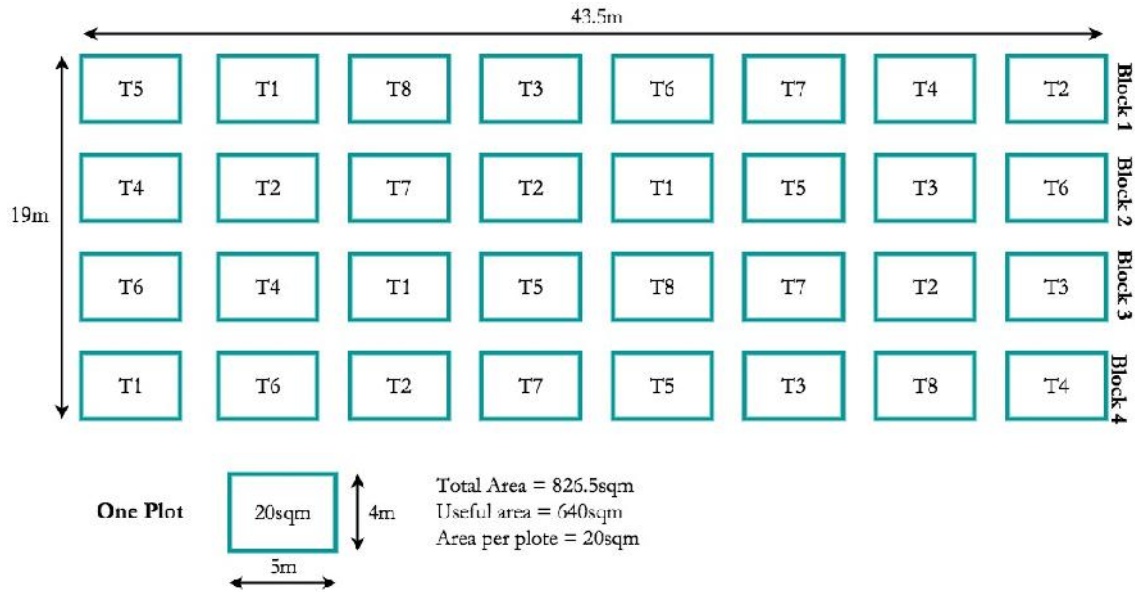
54 The experiment was carried out in the fields of the sheepfold of NCBA CLUSA International
55 company, in the region of Tetete, District of Gùrué, located to the North of Zambezia Province,
56 in the region of high Zambezia (Figure 1); which according to the Ministry of State
57 Administration-MAE (2005); is situated in a region dominated by the rock of the plateau zone
58 and the mountainous area whose altitude varies between 500 to 1000m, (pp.14-18). The
59 average annual rainfall is around 1,995.7 mm, mean annual evapotranspiration is 1,226.7 mm.
60 The average annual temperature is 21.90C. The highest temperature is registered in the month
61 of November (32.50°C) and the lowest in the month of July (12°C), (MAE, 2005).



62
63

64 **Fig. 1. Location of the study area. This figure shows the location map of the experiment,**
65 **which is Tetete site in Gùrué District, Zambezia Province.**

66 The experimental design used was the randomized complete block design in bi-factorial scheme
67 (4x2); the first factor composed of four agricultural practices and the second composed of two
68 varieties (TI-16 and TI-18), where the combination of the two factors were given 8 repeated
69 treatments in 4 blocks, totaling 32 plots. Each experimental unit occupied an area of 20 m² with
70 5 simple lines each. The separation between the parcels was 0.5m and between blocks 1 m. The
71 productive area was 640m² and the total area of the test was 826.5 m² (figure 2). The
72 description of the treatments is shown in table 1.



73

74

75

Fig. 2. Experimental design. This figure shows the experimental field design, which was divided into four blocks and eight treatments replicated in these four blocks.

76

Table 1. Description of the treatments including their codes, and specifications.

Treat.	Code	Agronomic practices
1	T1	Zero tillage + var. IT16
2	T2	Zero tillage + Mulch + var IT16
3	T3	Tillage + var. IT16
4	T4	Tillage + Mulch + var IT16
5	T5	Zero tillage + var. IT18
6	T6	Zero tillage + Mulch + var. IT18
7	T7	Tillage + var. IT18
8	T8	Tillage + Mulch + var. IT18

77

78

79

80

81

82

83

84

During the experiment, data about plant height (cm), number of pods per plant, 100 seed weight (g) and grain yield (kg ha⁻¹) were collected. The data collected from the experiment were organized in Microsoft Excel and analyzed using the statistical package SISVAR for the Analysis of Variance (ANOVA). The data that were significantly differentiated in the ANOVA, were submitted to the Tukey test at 5% of significance for the comparison of averages of the treatments. To determine the ANOVA; the schema of analysis of variance for experiment in randomized blocks for 2 factors was used.

85 **3. Results and discussion**

86 **Growth and Phonological Parameter (Plant Height)**

87 The results of plant height showed in table 2, reveals that the varieties as well as the
88 treatments (Agronomic practices) were differentiated when compared with their averages.
89 However, the variety IT-18 presented a good average result, especially in the practice
90 Tillage+Mulch, where the plants in this practice are revealed to be tall (with an average of
91 101.43cm) when compared to others.

92 **Table 2. Results of the plant height in two varieties analyzed under different agronomic**
93 **practices.**

Agronomic practices	Varieties	
	IT-16	IT-18
Tillage	69.43 aB	62.37 aA
Zero Tillage	88.10 bA	84.18 bA
Zero Tillage + Mulch	82.12 bA	90.63 bB
Tillage + Mulch	83.93 bA	101.43 cB
General Average	82.77	
CV (%)	5.12	
DMS	5.91	

94 *Means followed by the same lower-case letter in the columns, did not present significant differences
95 between treatments at 5% level of significance and means followed by the same capital letter in the lines did
96 not present significant differences between the varieties at the level of 5% of significance.

97 The results obtained in this study, are in agreement with the results verified by [Mekonnen and](#)
98 [JJ \(2016\)](#), while studying the **Growth and Yield Response of Cowpea** (*Vigna unguiculata* L. Walp.)
99 to Integrate the **Use of Planting Pattern and Herbicide Mixtures in** Wollo, Northern Ethiopia.
100 The average of plant height registered was between 86.0cm to 96.0cm. These results also show
101 that the different agronomic practices applied may have significant influence on plant height
102 when compared to the study developed by [Science, Aikins, and Afuakwa \(2008\)](#), where the
103 results obtained were below the average of 70.0cm.

104 **Number of pods per plant**

105 Significant differences (5%) from Tukey analysis were verified in the analysis of the number of
106 pods per plant (table 3). In this parameter, the variety IT-18 showed better results when
107 compared with the variety IT-16 and the treatment Tillage+Mulch had better performance in
108 both varieties, registering 15.90 and 23.90 for IT-16 **and IT-18 respectively.**

109 As expected from the plant height, the tillage showed lowest results when compared with the
110 other treatments in both varieties and results of low average of number of pods were verified
111 by [Afuakwa & Aikins \(2010\)](#) in their study of the **Effect of Four Different Tillage Practices** on

112 **Cowpea Performance.** Considering that the plant height is an important parameter linked with
 113 the productivity of the crops (Afuakwa and Aikins 2010), the results obtained in this study can
 114 also be justified based on the results obtained on plant height.

115 **Table 3. Results of the average number of pods per plant in two varieties analyzed under**
 116 **different agronomic practices.**

Agronomic practices	Varieties	
	IT-16	IT-18
Tillage	9.95 aA	16.33 aB
Zero Tillage	15.20 bA	19.85 abB
Zero Tillage + Mulch	15.13 bA	21.23 bcB
Tillage + Mulch	15.90 bA	23.90 cB
General Average	17.17	
CV (%)	10.71	
DMS	3.63	

117 *Means followed by the same lower-case letter in the columns did not present significant differences
 118 between treatments at 5% level of significance and means followed by the same capital letter in the lines did
 119 not present significant differences between the varieties at the level of 5% of significance.

120 In other study developed by Polthanee & Wannapat (2000) about the Tillage and Mulching
 121 effect on **Growth and Yield of Cowpea Grown Following Rice in the Post-Monsoon Season** of
 122 Northeastern Thailand, the values of number of pods per plant were low when compared to the
 123 results obtained here, even on the treatment where the Mulch were applied. However, in this
 124 study, it was reported that the Tillage affected the number of pods per plant. Based on this
 125 result, it can be inferred that the number of pods per plant does not depend only on the
 126 agronomic practices applied, but also on the varieties under analysis.

127
 128 **Hundred seed weight (grams)**

129 For the results of hundred seeds weight (in grams) (Table 4), it can be seen that the different
 130 varieties showed different responses, the variety IT-16, which registered lowest values of plant
 131 height and average of number of pods, presented better results in this parameter. However, for
 132 this parameter, the treatments Zero Tillage and Zero Tillage+Mulch, showed better results for
 133 both varieties.

134 The results obtained in our study, are in agreement with the results observed by A H, Abdel-Ati,
 135 El-Damarany, and Rashwan (2015), where they found an average of hundred seed weight of
 136 about 11 grams for one of the varieties under analysis. However, those results are low when
 137 compared to the results obtained by Relation and Duration (2008) while studying the Stability
 138 analysis of components characters in cowpea (*Vigna unguiculata* (L.) Walp), where the results
 139 obtained were based on an average of 18 grams.

140 **Table 4: Results of the average hundred seed weight in two varieties analyzed under different**
 141 **agronomic practices.**

Agronomic practices	Varieties	
	IT-16	IT-18
Tillage	12.60 aB	9.33 aA
Zero Tillage	12.90 aB	11.60 bA
Zero Tillage + Mulch	12.90 aB	10.28 aA
Tillage + Mulch	12.93 aB	9.10 aA
General Average	11.44	
CV (%)	5.36	
DMS	1.21	

142 *Means followed by the same lower-case letter in the columns, did not present significant differences
 143 between treatments at 5% level of significance and means followed by the same capital letter in the
 144 lines, did not present significant differences between the varieties at the level of 5% of significance.

145 On the other hand, the results obtained in this study are superior to the results observed by
 146 [Khaemba, Kinama, and Chemining'wa \(2017\)](#), whereby in their evaluation of the effect of tillage
 147 practice on growth and yield of three selected Cowpea varieties (same as the practices under
 148 analysis in this study), obtained averages between 7-10 grams. The highest average of hundred
 149 seeds weight were verified in the agronomic practice convectional tillage. From these results, it
 150 can be concluded that the hundred seeds averages do not rely only on the agronomic practices,
 151 but also on the varieties.

152
 153 **Grain Yield (kgha-1)**

154 Considered to be one of the major elements leading to improved results of grain yields; the
 155 hundred-seed weight showed a different trend in this study. The variety which had the better
 156 results of hundred seeds weight (IT-16) had a low grain yield average compared to the IT-18.
 157 The best results of grain yield were recorded in the variety IT-18 with an average of 2,600kgha-
 158 2. This value was observed in the treatment Zero Tillage + Mulch. On the other hand, the
 159 variety IT-16 showed a high grain yield of 1,950 Kgha-1 in the treatment Zero Tillage (Table 5).

160 These results are in agreement with the results reported by [Khaemba, Kinama, and](#)
 161 [Chemining'wa \(2017\)](#) who recorded a grain yield of a value between 890kgha and 1,720kgha,
 162 where the more valuable results were observed in zero tillage and tillage+mulch agronomic
 163 practices. However, for the grain yield, in this study, the varieties as well as the agronomic
 164 practices had a major contribution.

165

166 **Table 5: Results of the average of grain yield in two varieties analyzed under different**
 167 **agronomic practices.**

Agronomic practices	Varieties	
	IT-16	IT-18
Tillage	1,725.0 bcA	1,862.5 bA
Zero Tillage	1,950.0 cB	718.78 aA
Zero Tillage + Mulch	656.0 aA	2,600.0 cB
Tillage + Mulch	1,502.5 bA	1,737.5 bA
General Average	1594.06	
CV (%)	12.47	
DMS	391.83	

168 *Means followed by the same lower-case letter in the columns, did not present significant differences
 169 between treatments at 5% level of significance and means followed by the same capital letter in the
 170 lines, did not present significant differences between the varieties at the level of 5% of significance.

171 In other approach, it is documented that the zero tillage can reduce the input costs and labour,
 172 and conserve the soil, however it can lead to the negative effects on plant growth due to the
 173 soil compaction (Ewansiha, Udensi, and Kamara 2015). This affirmation is not in agreement with
 174 the results from the current study, where the high yield averages in both varieties (IT-16 and IT-
 175 18) were observed in the agronomic practices in which the zero tillage was used.

176 **Correlation between variables**

177 A positive relationship between the plant height, number of pods per plant, 100 seeds weight
 178 and grain yield were observed. However, the number of pods per plant and grain yield were not
 179 correlated. The relationship observed between hundred seeds weight and grain yield was
 180 positive, though it does not mean that an increment on the value of one will increase the value
 181 of the other one. This can be confirmed from the results of hundred seed weight (table 4) and
 182 grain yield (table 5), especially in the variety IT-18 where the mean of hundred seed weight was
 183 high in agronomic practice zero tillage, but then again registered lowest grain yield mean.

184 **Table 6: Correlation between the different analyzed parameters with the grain yield.**

Parameters	Plant height	Nº of pods per plant	Hundred seeds weight
Plant height			
Nº of pods per plant	0.669		
100 seeds weight	0.114	0.092	
Grain yield	0.010	-0.204	0.037

185 **4. CONCLUSION**

186 Based on the results, it can be concluded that in Gùrué District, Mozambique, the Cowpea grain
 187 yield is not only affected by the agronomic practices, but also by the varieties applied. Based
 188 on these findings, the usage of a combination of the varieties IT-16 and IT-18 in agronomic
 189 practice zero tillage and zero tillage + mulch respectively is recommended since they are the
 190 combinations which showed more greater results.

192 **REFERENCES**

- 193 A H, El-Shaieny A, Y Y Abdel-Ati, A M El-Damarany, and A M Rashwan. 2015. "Stability Analysis
 194 of Components Characters in Cowpea (*Vigna Unguiculata* (L.) Walp)." *Journal of*
 195 *Horticulture and Forestry* 7(2): 24–35. <http://www.academicjournals.org/JHF>.
- 196 Afuakwa, J J, and S.H.M Aikins. 2010. "Effect of Four Different Tillage Practices on Cowpea
 197 Performance." *World Journal of Agricultural Sciences* 6(6): 644–51.
- 198 Baeumer, K, and W A P Bakermans. 1973. "Zero-Tillage." *Advances in Agronomy* 25: 77–123.
- 199 Erenstein, Olaf. 2003. "Smallholder Conservation Farming in the Tropics and Sub-Tropics: A
 200 Guide to the Development and Dissemination of Mulching with Crop Residues and Cover
 201 Crops." *Agriculture, Ecosystems and Environment* 100(1–3): 17–37.
- 202 Ewansiha, Sylvester, Udensi Udensi, and Alpha Kamara. 2015. "Effect of Tillage on the Growth
 203 and Yield of Cowpea Varieties in Sudan Savanna Agroecology of Northern Nigeria." *Annual*
 204 *Research & Review in Biology* 5(3): 275–84.
 205 <http://www.sciencedomain.org/abstract.php?iid=668&id=32&aid=6486>.
- 206 Haruna, I. M., and A Usman. 2013. "Agronomic Efficiency of Cowpea Varieties (*Vigna*
 207 *Unguiculata* L. Walp) under Varying Phosphorus Rates in Lafia, Nasarawa State, Nigeria."
 208 *Asian Journal of Crop Science* 2(5): 209–2015.
- 209 Iruhvwu, Djulfxowxuh. 2015. "Production Guidelines for Cowpeas." *Department of Agriculture,*
 210 *Forestry and Fisheries, South Africa.* 1: 24.
- 211 Khaemba, R, J Kinama, and G Chemining'wa. 2017. "Effect of Tillage Practice on Growth and
 212 Yield of Three Selected Cowpea Varieties." *Journal of Experimental Agriculture*
 213 *International* 14(3): 1–11. <http://www.sciencedomain.org/abstract/16494>.

- 214 Maduakor, H. O., R. Lal, and O. A. Opara-Nadi. 1984. "Effects of Methods of Seedbed
215 Preparation and Mulching on the Growth and Yield of White Yam (*Dioscorea Rotundata*)
216 on an Ultisol in South-East Nigeria." *Field Crops Research* 9(C): 119–30.
- 217 Mekonnen, Getachew, and Sharma JJ. 2016. "Growth and Yield Response of Cowpea (*Vigna*
218 *Unguiculata* L. Walp.) to Integrated Use of Planting Pattern and Herbicide Mixtures in
219 Wollo, Northern Ethiopia." *Advances in Crop Science and Technology* 04(06).
220 [http://www.esciencecentral.org/journals/growth-and-yield-response-of-cowpea-vigna-](http://www.esciencecentral.org/journals/growth-and-yield-response-of-cowpea-vigna-unguiculata-l-walp-to-integrated-use-of-planting-pattern-and-herbicide-mixtures-in-wollon-2329-8863-1000245.php?aid=83077)
221 [unguiculata-l-walp-to-integrated-use-of-planting-pattern-and-herbicide-mixtures-in-](http://www.esciencecentral.org/journals/growth-and-yield-response-of-cowpea-vigna-unguiculata-l-walp-to-integrated-use-of-planting-pattern-and-herbicide-mixtures-in-wollon-2329-8863-1000245.php?aid=83077)
222 [wollon-2329-8863-1000245.php?aid=83077](http://www.esciencecentral.org/journals/growth-and-yield-response-of-cowpea-vigna-unguiculata-l-walp-to-integrated-use-of-planting-pattern-and-herbicide-mixtures-in-wollon-2329-8863-1000245.php?aid=83077).
- 223 Olusanya, A. OLATUNJI et al. 2016. "Yield and Growth Characteristics of Cowpea (*Vigna*
224 *Unguiculata*) as Affected by Prior Heat Stress and Nutrient Addition." *African Journal of*
225 *Agricultural Research* 11(43): 4269–76. [http://academicjournals.org/journal/AJAR/article-](http://academicjournals.org/journal/AJAR/article-abstract/CDFC79161373)
226 [abstract/CDFC79161373](http://academicjournals.org/journal/AJAR/article-abstract/CDFC79161373).
- 227 Polthanee, A., and S. Wannapat. 2000. "Tillage and Mulching Affect on Growth and Yield of
228 Cowpea Grown Following Rice in the Post-Monsoon Season of Northeastern Thailand."
229 *Kasetsart Journal of Natural Science* 34(2): 197–204.
- 230 Putnam, By Dan, Steve Orloff, and Tracy Ackerly. 2000. "Agronomic Practices and Forage
231 Quality." *Changes*: 10–12.
- 232 Relation, L In, and Sunshine Duration. 2008. "Growth and Yield Response of Soybean." 1(2): 45–
233 50.
- 234 Science, Biological, S H M Aikins, and J J Afuakwa. 2008. "Growth and Dry Matter Yield
235 Responses of Cowpea." *ARPN Journal of Agricultural and Biological Science* 3(586): 50–54.
- 236 Unger, P. W., and T. M. McCalla. 1980. "Conservation Tillage Systems." *Advances in Agronomy*
237 33(C): 1–58.
- 238 Walker, Tom, and Benedito Cunguara. 2016. "Avaliação Dos Rumos Da P & D Do Feijão Nhemba
239 No Programa ' Feed the Future ', Da USAID , Em Moçambique Em 2016."
240