

CONSERVATION FARMING UNIT

**ANALYSES OF CROP TRIALS UNDER
FAIDHERBIA ALBIDA**

**RESULTS OF CROP YIELDS FOR THE 2010/2011 AGRICULTURAL
SEASON AND OVERALL SUMMARY OF YIELDS AND YIELD
TRENDS FROM 2008 TO 2011**

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EXECUTIVE SUMMARY

The Conservation Farming Unit (CFU) of the Zambia National Farmers Union (ZNFU) has been promoting conservation farming among farmers in the medium rainfall region of Zambia. Among the many farming practices the CFU has been promoting, is the planting of *Faidherbia albida* trees in crop fields to enhance the fertility of soils. To demonstrate the benefits of *Faidherbia albida* on crop yields, the CFU initiated crop trials in the 2007/2008 agricultural season in the Central region, which were extended to the Western, eastern and Southern Region in the 2008/2009 agricultural season and continued till the 2010/2011 agricultural season when the trials were concluded. Four plots were established under canopies of mature *Faidherbia albida* and four outside canopies on the leeward side of the trees. Land on each plot was prepared by digging permanent planting basins using a hand hoe. The dimensions of the basins were 15 cm x 30 cm, with a depth of about 25 cm. The spacing between the rows was 90 cm between and 70 cm within rows. Each plot had 10 rows containing 12 planting basins, giving a total of 120 planting basins per plot. Maize, cotton, soya bean and groundnuts were grown in the plots and rotated every season. No fertilizers were applied to the plots over the four year period when the trials were conducted.

Results of the crop trials showed that yields of maize grown under canopies of *Faidherbia albida* were significantly higher than those of maize grown outside canopies in all the four regions of Zambia where the trials were conducted and in the four agricultural seasons. The average yield of maize under the canopies of *Faidherbia albida* was about 5.0 metric tonnes per hectare compared to an average of about 2.0 metric per hectare for maize grown outside canopies of *Faidherbia albida*. No statistically significant differences were observed between yields of cotton, soya bean and groundnuts grown under and outside canopies of *Faidherbia albida*.

Trends in the yields of maize, soya bean and groundnuts grown both under and outside canopies of *Faidherbia albida* showed a progressive increase from the first to third year of cultivation after which the yields either remained constant or began declining. In contrast, the yield of cotton showed a progressive decline from the first year of cultivation through to the fourth year of cultivation. The results of the trials indicate that maize, soya beans and groundnuts can sustainably be grown in rotation under canopies of *Faidherbia albida* for a period of three year without applying chemical fertilizers under small holder farmer conditions in Agro-ecological region II of Zambia.

Results of these trials have clearly demonstrated the benefits of growing maize under canopies of mature *Faidherbia albida* trees in a crop rotation with legumes. The trials have also demonstrated the benefits of growing crops in rotation on sustaining the productivity of the land as all the crops grown except cotton. Maize is the crop that showed the greatest benefits to being grown under canopies of *Faidherbia albida*, followed by soya beans. Cotton and groundnuts do not seem to produce good yields under canopies of *Faidherbia albida* and therefore may not be the right crops to grow under these trees. Cotton does not appear to be suitable for cultivation under canopies of *Faidherbia albida*.

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INTRODUCTION

The Conservation Farming Unit (CFU) has been carrying out work on various aspects of conservation agriculture in Zambia. Its activities have mainly been focused in the Agro-ecological Zone II of Zambia, commonly referred to as the medium rainfall region which is characterized by a mean seasonal rainfall of between 800 and 1000 mm. One of the activities that the CFU has been trying to promote among farmers is the growing of *Faidherbia albida* trees in their crop fields. *Faidherbia albida* locally known as Musangu in Southern Zambia is a leguminous tree that is known to improve the fertility of soils under its canopy.

To demonstrate the benefits of mature *Faidherbia albida* trees on the fertility of soils, the CFU initiated crop trials in the four regions of Zambia where it has been operating. The main objective of the trials was to assess the effects of mature Musangu tree on yields of maize (*Zea mays*), cotton (*Gossypium Hirsutum*), soya beans (*Glycine max*) and groundnuts (*Arachis hypogea*) when grown in a rotation without applying any fertilizers. The goal was to compare yields of crops grown under the canopies of mature *Faidherbia albida* trees and those grown outside the canopies. In each region 10 trial sites were established. Four plots were demarcated under the canopy of a mature *Faidherbia* tree, while another four were demarcated in a rectangular block on the leeward side of the tree. The field layout of the crop trials is presented in Figure 1.

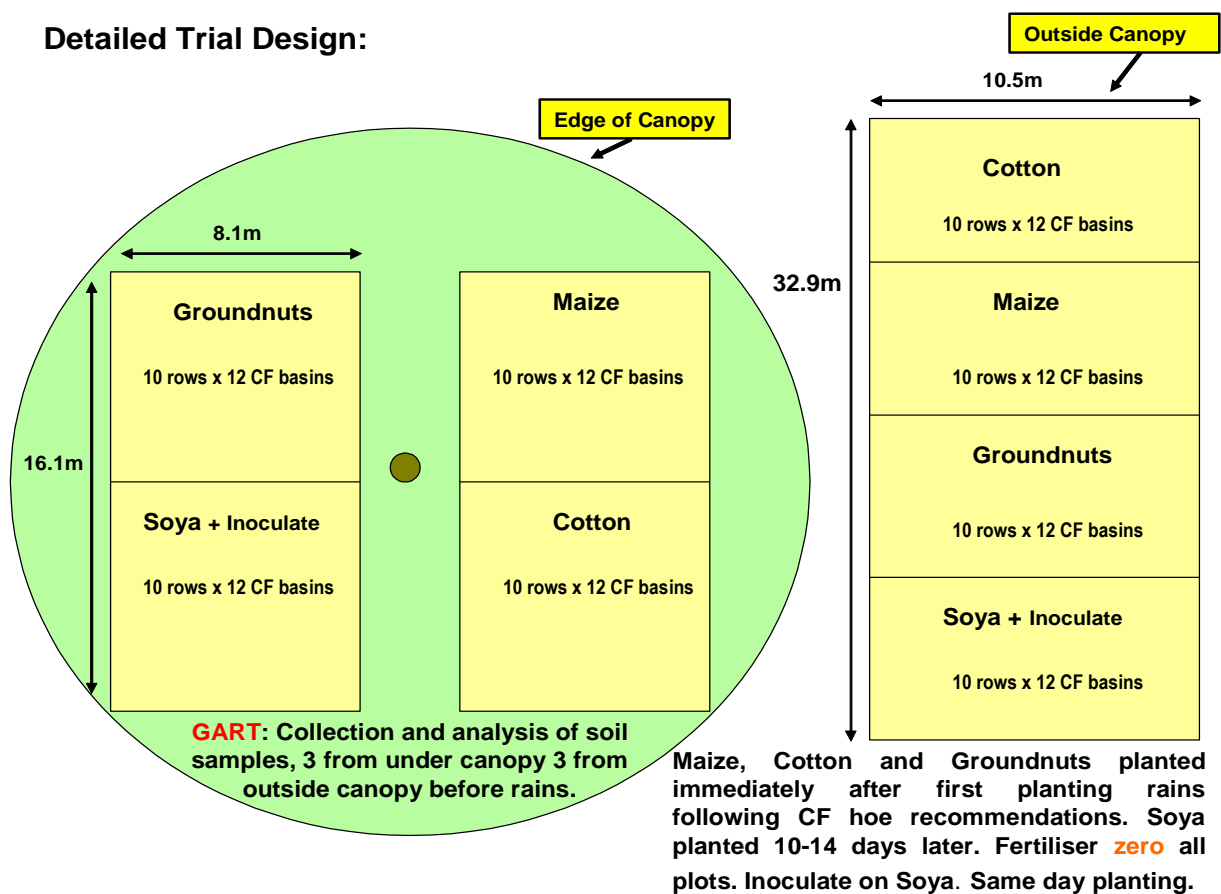


Figure 1. Field Layout of the Faidherbia Albida Trials

Land on each plot was prepared by digging permanent planting basins using a hand hoe. The dimensions of the basins were 15 cm x 30 cm, with a depth of about 25 cm. The spacing between the rows was 90 cm between and 70 cm within rows. Each plot had 10 rows containing 12 planting basins, giving a total of 120 planting basins per plot. Maize, cotton and groundnuts were planted immediately after the first rains of the season in each location, while soya bean was planted 10 to 14 days after the first rains. The trials were carried out under rainfed conditions. The typical crop growing season defined by the availability of water from rainfall in Region II starts from about mid November to about mid April.

All recommended agronomic practices for each crop were followed as much as possible until the time of harvest. The harvested grain (for maize, soya bean and groundnuts) and the lint (for cotton) were measured and recorded. The crop yields in kilograms per plot were converted to yield in kilograms per hectare by multiplying the yield per plot by a factor of 132.3, obtained by dividing the approximate number of basins per hectare of 15,873 by the 120 basins present per plot in a crop trial at each site.

The CFU trial sites were conducted in the Central, Eastern, Southern and Western Regions which are all in Agro-ecological region II which receives a mean seasonal rainfall of between 800 and 1000 mm. Figure 2 shows the distribution of Agro-ecological zones in Zambia and their boundaries. Agro-ecological zone II is the main region that produces most of the maize, soya beans, wheat, tobacco and cotton in Zambia.

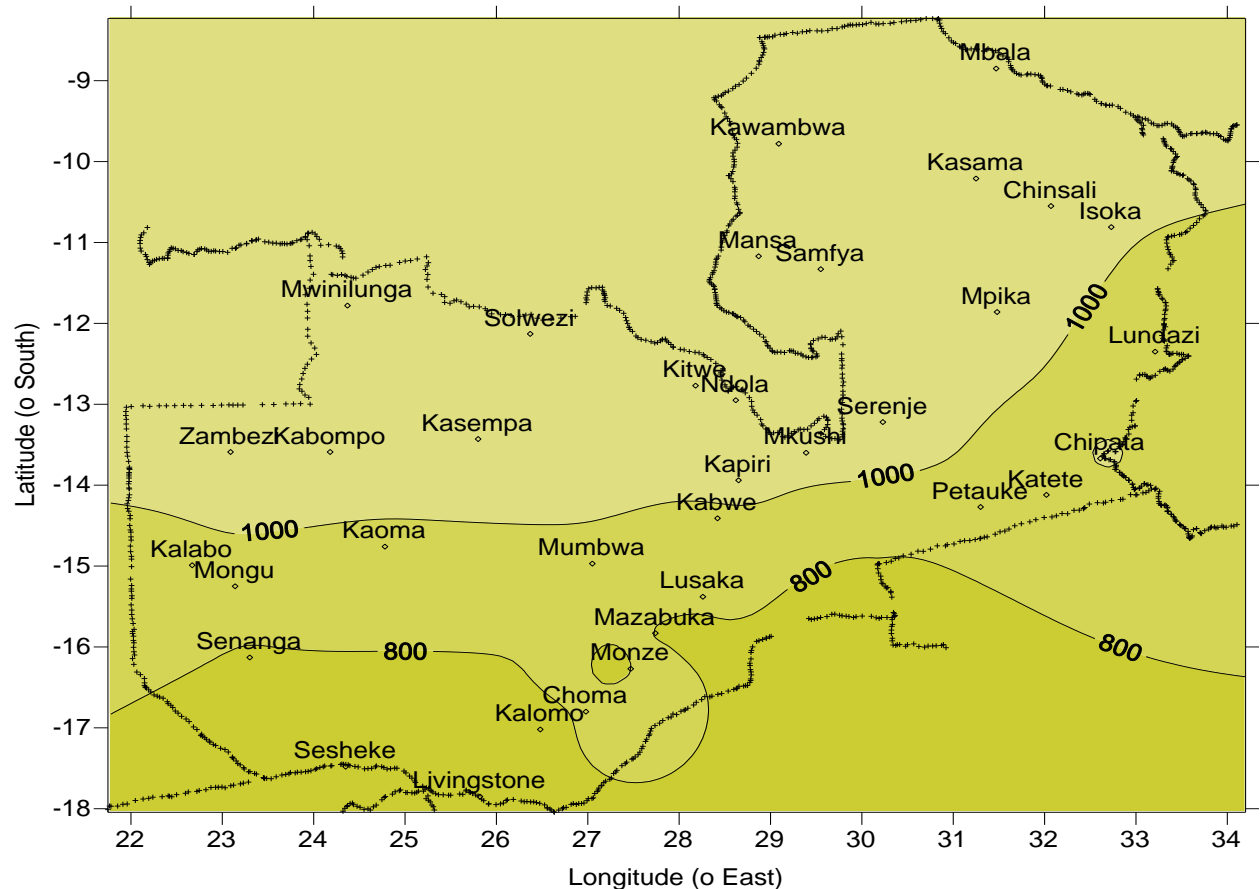


Figure 2. Map of Zambia showing the Agro-ecological zones and their boundaries

OBJECTIVES

This report presents results of crop trials on the comparison of yields of maize, cotton, groundnuts and soya beans grown in rotation on plots under and outside canopies of *Faidherbia albida* with no application of fertilizer. The first part presents yield results for the 2010/2011 agricultural season. These are then followed by summaries of results for the 2009/2010, 2008/2008 and 2007/2008 agricultural seasons. The last part of the report presents the trend in the yields of the four crops over the four agricultural seasons during which the trials were conducted.

The main questions that the trials were intended to answer were:

- 1 Are there significant differences in crop yields between plants grown on plots under and outside canopies of mature *Faidherbia albida* trees when no fertilizer is applied?
- 2 What are the trends in crop yield over a period of four seasons when crops are grown in rotation on plots under and outside canopies of mature *Faidherbia albida* when fertilizer is not applied?

DATA ANALYSIS

Crop yields obtained from plots at various trial sites in the four operational regions of the CFU were compiled by staff from the CFU. Yield data were checked for errors and then entered in Excel. The data were then transferred into the Statistical Analysis Software SAS version 9.0 for statistical analyses. Before carrying out the statistical tests the data were further rechecked and corrected where needed. To establish whether there were significant differences between yields of crops grown under and outside canopies of *Faidherbia albida* within each region the General Linear Models (GLM) Procedure was used to carry out the analyses. To compare means values of treatments the Least Significant Difference (LSD) was used to carry out the t-test. The procedures just described were also employed when analyzing aggregated yields across the four regions. The level of significance used to establish whether there were significant differences between treatments means was 0.05. To assess the trends in yield with time, bar graphs of mean yields versus time plotted using the graphics software Sigma Plot Version 11. Yield data and statistics of crop yields for the 2010/2011 season are presented in the Appendices at the end of the report.

RESULTS

Crop Yields for the 2010/2011 Agricultural Season

Crop yields obtained in the 2010/2011 agricultural season from the four operational regions of the CFU were analyzed. Results of analyses of crop yields for each of the four regions are summarized in Table 1. In all the four regions, yields of maize from plots under canopies of *Faidherbia trees* were significantly ($p < 0.05$) higher than those from plots outside the canopies. No statistically significant differences were observed between the yields of cotton,

soya beans and groundnuts grown under and outside canopies of *Faidherbia albida*, although yields of grounds and cotton were generally higher in plots outside the canopies compared to those under the canopies. However, yields of soya beans in plots under the canopy were generally higher than those in plots outside the canopy. Crop yield results for the 2010/2011 season show that maize had the greatest benefit in yield when grown under canopies of mature *Faidherbia albida* trees.

Yield data obtained for the different crops in the 2010/2011 agricultural season were then aggregated across the four regions and analyzed. Results of these analyses are presented in Table 2. The combined results of crop yields across the four regions show that in the 2010/2011 agricultural season, grain yields of maize and soya beans from plots under canopies of *Faidherbia albida* were significantly ($p < 0.05$) higher than those from plots outside the canopies. These results indicate that there were significant yield benefits when maize and soya beans were grown in plots under canopies of *Faidherbia albida*. On the other hand, no significant yield differences were observed for cotton and groundnuts whether grown under or outside canopies of *Faidherbia albida*.

Table 1. Average yields of crops grown under and outside canopies of Musangu (*Faidherbia albida*) in the different CFU regions in the 2010 /2011 agricultural season.

Region	Number of Trials	Crop	Average Yield (kg/ha)		Significance at 0.05
			Under Canopy	Outside Canopy	
Western	7	Cotton	683	507	Non Significant
	7	Groundnuts	287	355	Non Significant
	7	Maize	4119	2031	Significant
	7	Soya beans	772	437	Non Significant
Central	10	Cotton	747	1310	Non Significant
	10	Groundnuts	430	655	Non Significant
	10	Maize	5542	3565	Significant
	10	Soya beans	2060	1005	Significant
Eastern	10	Cotton	1385	1678	Non Significant
	10	Groundnuts	1325	934	Non Significant
	10	Maize	4702	2059	Significant
	10	Soya beans	1293	675	Significant
Southern	10	Cotton	951	1083	Non Significant
	10	Groundnuts	750	934	Non Significant
	10	Maize	6041	3028	Significant
	10	Soya Beans	2050	1242	Non Significant

Table 2. Average yields of crops grown under and outside canopies of Musangu (*Faidherbia albida*) across different regions in the 2010/2011 agricultural season.

Crop	Number of Trials	Average Crop Yield (kg/ha)		Significance at 0.05 level
		Under canopy	Outside canopy	
Cotton	37	983	1236	Non Significant
Groundnuts	37	755	764	Non Significant
Maize	37	5144	2734	Significant
Soya beans	37	1608	881	Significant

Crop Yields for the 2009/2010 Agricultural Season

The results of analyses of crop yields for the four regions in the 2009/2010 agricultural season are summarized in Table 3. Maize yields from plots under canopies of *Faidherbia albida* were significantly ($p < 0.05$) higher than those from plots outside the canopies in the Eastern, Southern and Western regions. In the Central region, no statistically significant ($p = 0.05$) difference in the yield of maize was observed between plants grown in plots under canopies of *Faidherbia albida* and those grown in plots outside canopies. No significant differences in yields of cotton and soya bean were observed for plants grown on plots under and outside canopies of the Musangu tree in all four regions. A similar observation was made for groundnuts except that in the Central region, the average yield of groundnuts on plots outside canopies of *Faidherbia albida* was significantly ($p < 0.05$) higher than those grown on plots under the canopy.

It is worth noting that although the difference in the average yields of maize grown under and outside canopies of the Musangu tree in the trials in the Central region was not statistically significant; the actual difference in yield was practically significant. The average yield of maize from plots under *Faidherbia* canopies was 1755 kg/ha greater than that obtained for the crop grown outside canopies of *Faidherbia albida*. This difference translates to an extra 35 x 50 kg bag of maize grain per hectare for the crop grown in plots under canopies of *Faidherbia albida* which is significant practically.

Table 3 Average yields of crops grown under and outside canopies of *Faidherbia albida* in different regions in the 2009/ 2010 agricultural season.

Region	Trials	Crop	Average Yield (kg/ha)		Significance at 0.05
			Under Canopy	Outside Canopy	
Western	7	Cotton	1124	1032	Non Significant
		Groundnuts	701	913	Non Significant
		Maize	4497	2367	Significant
		Soya Beans	1071	820	Non Significant
Central	10	Cotton	1019	1610	Significant
		Groundnuts	892	1601	Significant
		Maize	5560	3806	Non Significant
		Soya Beans	2984	2655	Non Significant
Eastern	10	Cotton	1664	1680	Non Significant
		Groundnuts	1091	1634	Non Significant
		Maize	6389	2493	Significant
		Soya Beans	1892	1931	Non Significant
Southern	10	Cotton	643	934	Non Significant
		Groundnuts	2487	1825	Non Significant
		Maize	6111	1865	Significant
		Soya Beans	714	873	Non Significant

The aggregated average yields of the crops across the four regions are presented in Table 4. The results indicate that there were no statistically significant differences observed between the yields of cotton, soya beans, and groundnuts grown under and outside canopies of *Faidherbia albida*. For maize however, significantly ($p < 0.05$) higher yields were obtained from plots under canopies of *Faidherbia albida* than from outside the canopy.

As was observed in the yields of the 2010/2011 agricultural season, in the 2009/2010 agricultural season, maize yields under canopies of mature *Faidherbia albida* were significantly higher than those on plots outside the canopy. Yields of cotton and groundnuts appeared to be generally higher in plots outside the canopy than in plots under the canopy. On the other hand, yields of soya bean in plots under the canopy seemed to be slightly higher than those in plants outside the canopy.

Table 4. Average yields of crops grown under and outside canopies of *Faidherbia albida* across different regions in the 2009/2010 agricultural season.

Crop	Trials	Average Yield (kg/ha)		Significance at 0.05 level
		Under canopy	Outside canopy	
Cotton	40	1116	1310	Non Significant
Groundnuts	40	1293	1493	Non Significant
Maize	40.	5640	2633	Significant
Soya beans	40	1665	1570	Non significant

Crop Yields for the 2008/2009 Agricultural Season

The crop yields obtained from trials in the different CFU regions in the 2008/2009 agricultural season are presented in Table 5. In all the four regions maize yields in plots under canopies of *Faidherbia albida* were significantly higher than those in plots outside the canopies of the *Faidherbia* trees. For cotton, groundnuts and Soya beans no statistically significant differences in yield were observed between crops grown under canopies of *faidherbia* or outside the canopies of *faidherbia*.

Table 5 Average yields of crops grown under and outside canopies of *Faidherbia albida* in different regions in the 2008 /2009 agricultural season.

Region	Number of Trials	Crop	Average Yield (kg/ha)		Significance at 0.05
			Under Canopy	Outside Canopy	
Western	7	Cotton	1020	1096	Non Significant
	7	Groundnuts	1342	926	Non Significant
	7	Maize	3723	1946	Significant
	7	Soya beans	1171	775	Non Significant
Central	10	Cotton	866	1627	Non Significant
	10	Groundnuts	1045	1759	Non Significant
	10	Maize	4815	2050	Significant
	10	Soya beans	1561	1164	Non Significant
Eastern	10	Cotton	1865	2751	Non Significant
	10	Groundnuts	1415	1600	Non Significant
	10	Maize	5635	3386	Significant
	10	Soya beans	1521	2037	Non Significant
Southern	10	Cotton	1322	1573	Non Significant
	10	Groundnuts	609	647	Non Significant
	10	Maize	5754	2765	Significant
	10	Soya Beans	1601	1230	Non Significant

In the 2008/2009 season, the second year of trials the yield results clearly showed the benefits of growing maize under canopies of mature *Faidherbia albida*. No statistically significant differences in yield were observed between crops grown under and outside canopies of *Faidherbia albida*, for cotton, soya beans and groundnuts. Despite this, notably higher yields of soya beans of about 400 kg/ha were obtained on plots under canopies of *Faidherbia albida* compared to those of plots outside canopies. For cotton, lower yields were observed on plots under canopies than on outside canopies of *Faidherbia albida*. Yields of groundnuts showed a variable pattern, though in general, yields obtained from plots under the canopies of *Faidherbia albida* seemed lower than those from plots outside the canopy. In general maize and soya beans appeared to yield higher on plots under the canopy than on plots outside the canopy, while the opposite seemed to be the case for cotton and groundnuts, which appeared to yield higher on plots outside canopies of *Faidherbia albida* than under the canopies.

The combined average yields of crops outside and under canopies of mature *Faidherbia albida* across the four regions in the 2008/2009 season are presented in Table 6. The results show that the only significant difference in yield was in maize where yields from plots under canopies of *Faidherbia albida* were significantly higher than those from plots outside the canopies. The increase in yield is equivalent to about 2.5 metric tonnes of grain per hectare. This is about twice the yield obtained in plots outside the canopies of *Faidherbia albida*. The results in Table 6 are consistent with observations obtained from individual regions summarized in Table 5, which revealed this trend.

Table 6. Average yields of crops grown under and outside *Faidherbia albida* canopies across different regions in the 2008/2009 agricultural season

Crop	Trials	Average Yield (kg/ha)		Significance at 0.05 level
		Under canopy	Outside canopy	
Cotton	37	1294	1823	Non Significant
Groundnuts	37	1083	1275	Non Significant
Maize	37	5084	2585	Significant
Soya beans	37	1484	1344	Non significant

No statistically significant differences were observed in yields of cotton, soya beans and groundnuts grown outside and under canopies of *Faidherbia albida* across the four regions as observed with the data from the various regions. Results of the analyses of yield data aggregated across the four regions once more indicate the clear benefits of growing maize on plots under canopies of *Faidherbia albida* compared to adjacent plots outside the canopies. The yield data presented in Table 6 further corroborate the general trend for the yields of cotton and groundnuts observed in Table 5 which showed that these crops had slightly better yields on plots outside canopies of *Faidherbia albida* than under the canopies.

Crop Yields for the 2007/2008 Agricultural Season

Crops trials to assess the effects of mature *Faidherbia albida* on the fertility of soils and on the productivity of the land were initiated in the 2007/2008 agricultural season. In this season the trials were conducted in the Central Region of the CFU only. Results of crop yields for this season are presented in Table 7. In the first season, the only statistically significant differences observed between the yields of crops grown under and outside canopies of mature *Faidherbia albida* trees were in maize. Maize grown under canopies *Faidherbia albida* had an

equivalent yield of 3 metric tonnes per hectare compared to an average yield of 1.0 metric tonne per hectare obtained for maize grown outside the canopies.

Table 7. Average yields of crops grown under and outside canopies of mature *Faidherbia albida* in the 2007 /2008 agricultural season.

Region	Trials	Crop	Average Yield (kg/ha)		Significance at 0.05 Level
			Under Canopy	Outside Canopy	
Central	8	Cotton	1720	1154	Non Significant
	8	Groundnuts	480	810	Non Significant
	8	Maize	2976	1025	Significant
	8	Soya beans	380	513	Non Significant

No statistically significant differences in yield were observed for cotton, groundnuts and soya beans grown on plots under and outside canopies of *Faidherbia albida*. In the first season, the yields of cotton and groundnuts in plots outside canopies of *Faidherbia albida* were comparatively higher than those of crops in plots under the canopies. Soya bean yields on the other hand were comparatively higher outside the canopy than under the canopy.

TRENDS IN CROP YIELD BETWEEN 2008 AND 2011 AGRICULTURAL SEASONS

The crop trials to assess the effect of mature *Faidherbia albida* on crop yield were conducted over four crop growing seasons starting in the 2007/2008 agricultural season and ending in the 2010/2011 agricultural season. Trials in the first season were limited to the Central Region, but were further extended to the Southern, Eastern and Western Regions in subsequent seasons. The combined average crop yields across the region obtained in the four seasons are presented in Table 8.

Table 8. Average yields of crops grown under and outside canopies of mature *Faidherbia albida* across regions between 2007 and 2011.

Season	Maize		Cotton		Soya beans		Groundnuts	
	Under	Outside	Under	Outside	Under	Outside	Under	Outside
2007/2008	2976	1025	1720	1154	380	513	480	810
2008/2009	5084	2585	1294	1823	1487	1344	1083	1275
2009/2010	5640	2633	1116	1310	1665	1570	1293	1493
2010/2011	5144	2734	983	1236	1608	881	755	764
Mean	4711	2244	1278	1105	1285	1077	903	1086

An analysis of the trends in the crop yields with time over the four seasons has carried out to observe the pattern in the crops yields and to compare yields obtained from plots under and outside canopies of *Faidherbia albida*. The following section presents results of finding on the trends in crop yield with time for each of the four crops separately.

TRENDS IN MAIZE CROP YIELD

The trends in the combined yields of maize across different regions over four agricultural seasons from 2008 to 2011 are presented in Figure 3. The results show that the yields of maize grown in plots grown under canopies of *Faidherbia albida* were consistently higher than those from plots outside the canopies in all the four agricultural seasons.

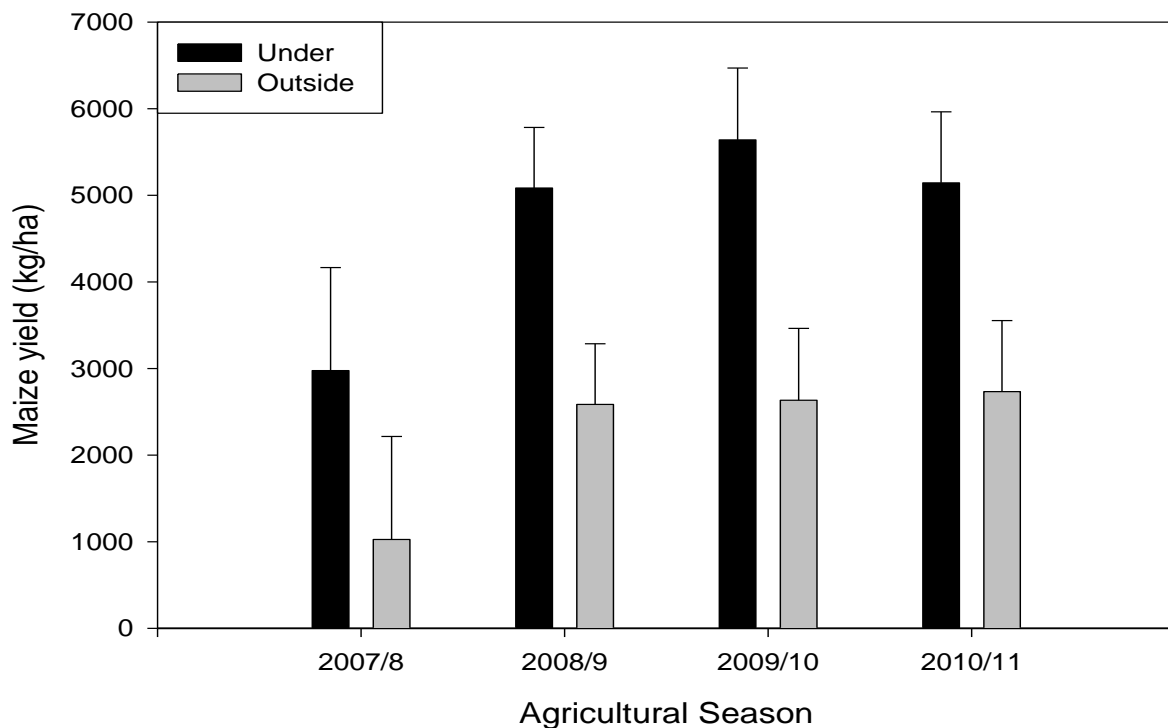


Figure 3. Mean yields of maize under and outside canopies of *Faidherbia albida* over four agricultural seasons

The trend in the yield of maize grown under *Faidherbia albida* shows an increase with time from the first to the third year of cultivation. In the fourth year the yields declined slightly but not significantly from what was obtained in the third year. There was an increase in yield that peaked in the third year and remained at about the same level in the fourth year. The initial yield of maize under conservation farming was about 3 metric tonnes per hectare in the first year which increased to 5.5 metric tonnes in the third year and remained at about 5.0 metric tonnes per hectare in the fourth year.

A similar trend of an increase in yield was observed for maize grown in plots outside canopies of *Faidherbia albida*. However, unlike the plots under canopies of *Faidherbia albida* where the yield increase occurred over 3 seasons, the yields on plots outside canopies of *Faidherbia albida* peaked in the second year at an average yield of about 2.5 metric tonnes and stabilized at that level through to the fourth year.

The trends in the yield of maize obtained from plots both under and outside the canopies of *Faidherbia albida* are quite interesting and instructive. The observed yield trend is in contrast with what small scale farmers who practice mono-cropping with maize experience in Zambia. The average yield of maize of 2.5 metric tonnes per hectare obtained in plots outside the canopies of *Faidherbia albida* after four years of cultivation without applying chemical fertilizers are actually higher than the reported average yield of 1.5 metric tonnes per hectare obtained by small scale farmers in Zambia who apply low rates of chemical fertilizers. These results underscore the importance of crop rotation in the management of the fertility of the land. If farmers can obtain yields of 2.5 metric tonnes of maize per hectare simply by practicing crop rotation and following other recommended agronomic practices, there is a lot of scope for improving yields even by resource poor farmers.

More significantly, the benefits of growing maize in rotation with leguminous crops under canopies of mature *Faidherbia albida* have been clearly demonstrated by the results of these trials. The attainment of yields equivalent to 5.0 metric tonnes of maize per hectare on plots under canopies of mature *Faidherbia albida* after 4 years of continuous cultivation without applying any fertilizers is a remarkable achievement. The maize yields obtained on plots under canopies of mature *Faidherbia albida* trees after four years cultivation are more than twice what the average yield obtained by many small scale farmers in Zambia who apply chemical fertilizers. It is clear that growing maize in rotation with leguminous crops under canopies of *Faidherbia albida* significantly increases the productivity of the land compared to mono-cropping maize using recommended rates of chemical fertilizers. With such results, the only question one may ask is “How feasible it is for small holder farmers to grow of *Faidherbia albida* in their fields and how long it takes for the benefits observed in these trials to be realized?”

YIELD TRENDS FOR COTTON

The trends in the average yields of cotton obtained from plots under and outside canopies of *Faidherbia albida* over four seasons across the different regions of Zambia where the CFU is operating are presented in Figure 4. In the first year of cultivation, slightly higher yields of cotton were obtained from plots under canopies of *Faidherbia albida* than in plots outside canopies of *Faidherbia albida*. However from the second year through to the fourth year cotton yields under canopies of *Faidherbia albida* were consistently lower than those obtained from plots outside the canopies. The general trend seems to indicate that cotton does not grow well on plots under *Faidherbia albida* canopies. Field observations of cotton plants grown under canopies of *Faidherbia albida*, reveal that cotton plants grown under canopies of *Faidherbia albida* tend to grow tall and very vegetatively, while those grown on plots outside the canopies tend to grow less vegetatively and produce more lint. This may probably be due the fact that soils under *Faidherbia albida* have much higher levels of nitrogen compared to those outside canopies of *Faidherbia albida*.

The general trend in the yields of cotton with time indicates a general progressive decline in yield for cotton grown under canopies of *Faidherbia albida* with time. The average yield declined from about 1.7 metric tonnes per hectare in the first year to about 0.9 metric tonnes per hectare in the fourth year. For crops grown outside canopies of *Faidherbia albida*, there was an initial increase in yield in the second season, this however progressively declined from the second year up to the fourth year.

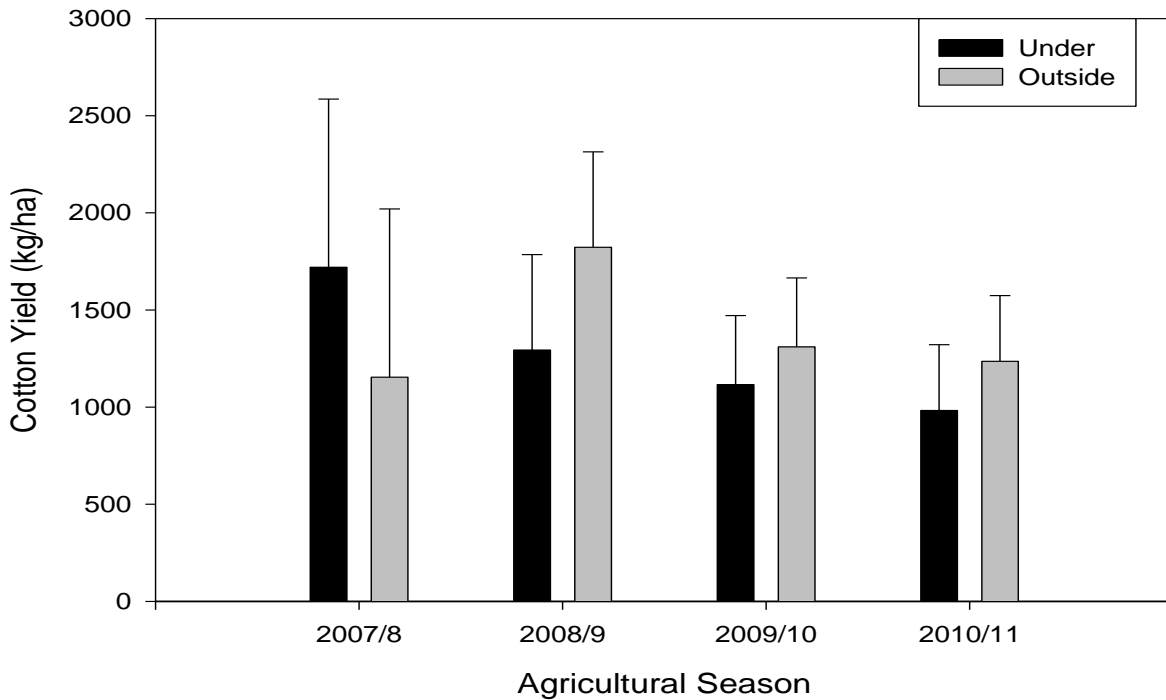


Figure 4. Mean yields of cotton under and outside canopies of *Faidherbia albida* over four agricultural seasons.

It is quite evident from the results in Figure 4 that growing cotton without applying fertilizers is not likely to be a feasible practice even when crop rotation is practised. The comparatively poor yields obtained from cotton grown under canopies of *Faidherbia albida* may be due to the high levels of nitrogen associated with soils under canopies of *Faidherbia albida*.

YIELD TRENDS FOR GROUNDNUTS

Groundnuts were among the legumes included in the trials to assess the effect of *Faidherbia albida* on soil productivity in a rotation without the application of any chemical fertilizers. A summary of the yields obtained over the four years of trials are presented in Figure 5. The average yields of groundnuts from plots under canopies of *Faidherbia albida* were slightly higher than those from plots outside the canopies in the first three years of the trials.

The general trend in the yields shows a progressive increase in the yield of groundnuts both under and outside the canopies of *Faidherbia albida* from the first to third year of cultivation. The yields reached their peak in the third year of trials and then significantly declined in the fourth year. It is most likely that the crop rotation contributed to the yield increase in the first

three years of the trials. After the third the soils probably became depleted of plant nutrients, and could therefore no longer sustain the comparatively high crop yields beyond the third year. The decline in yield after the third year is a probable indicator that after this period the nutrient reserves in soils were exhausted and therefore unable to sustain high crop yields without external replenishment of nutrients.

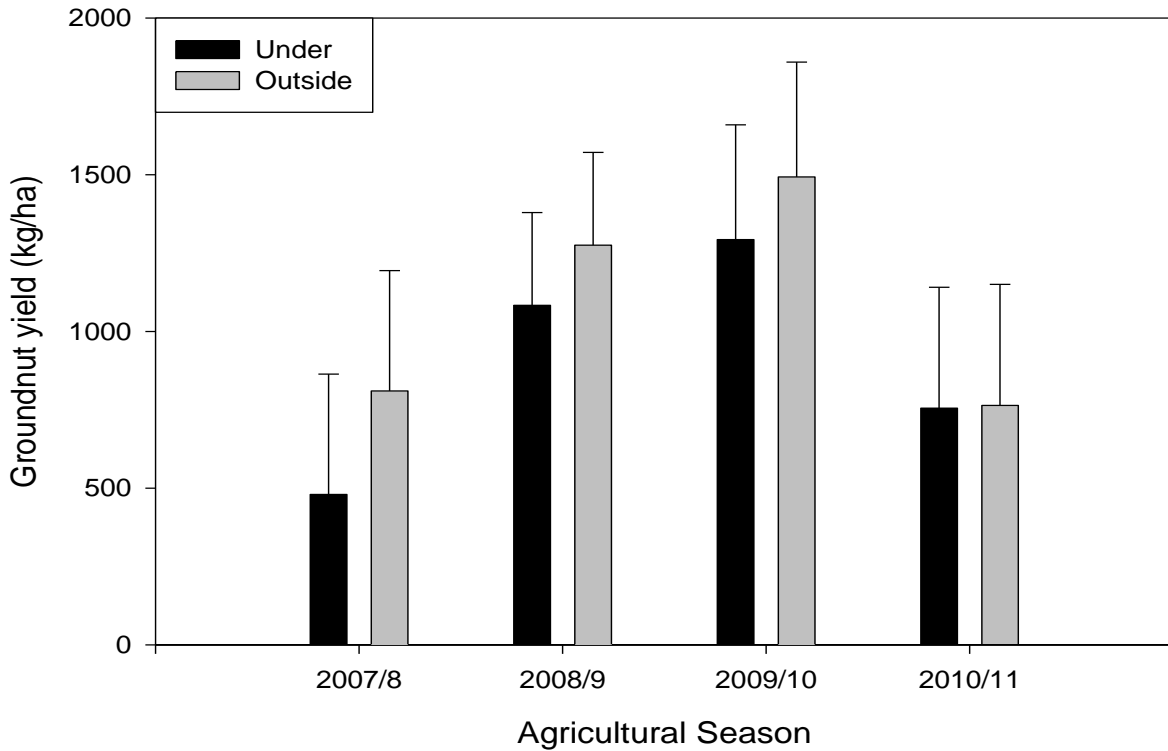


Figure 5. Mean yields of groundnuts under and outside canopies of *Faidherbia albida* over four seasons

The key lesson from these trials is that while crop rotation is essential for improving the productivity of the land, it cannot substitute the need for replenishing nutrients removed from the soil by crops harvested from the fields. A combination of crop rotation and the following of recommended agronomic practices with the judicious use of fertilizers are necessary for sustainable crop production. Despite the observed decline in yield after 3 years, it is remarkable that groundnut yields progressively increased over a period of 3 years. This is much in contrast with what many small scale farmers experience under mono-cropping systems with maize as the sole crop.

YIELD TRENDS IN SOYA BEANS

Soya bean was the other leguminous crop that was included in the rotation. The yields of soya beans across the four regions over the four year period are presented in Figure 6. During the four year increased progressively and peaked during the third year. For crops grown outside the canopies of *Faidherbia albida* the yield significantly declined in the fourth year, while it remained similar to what was obtained in the third year for crops grown under canopies of *Faidherbia albida*. The results indicate a rapid drop in yield of soya bean

occurred after the third year of cultivation in plots outside canopies of *Faidherbia albida* while yields in plots under the canopies remained similar to those obtained in the third year.

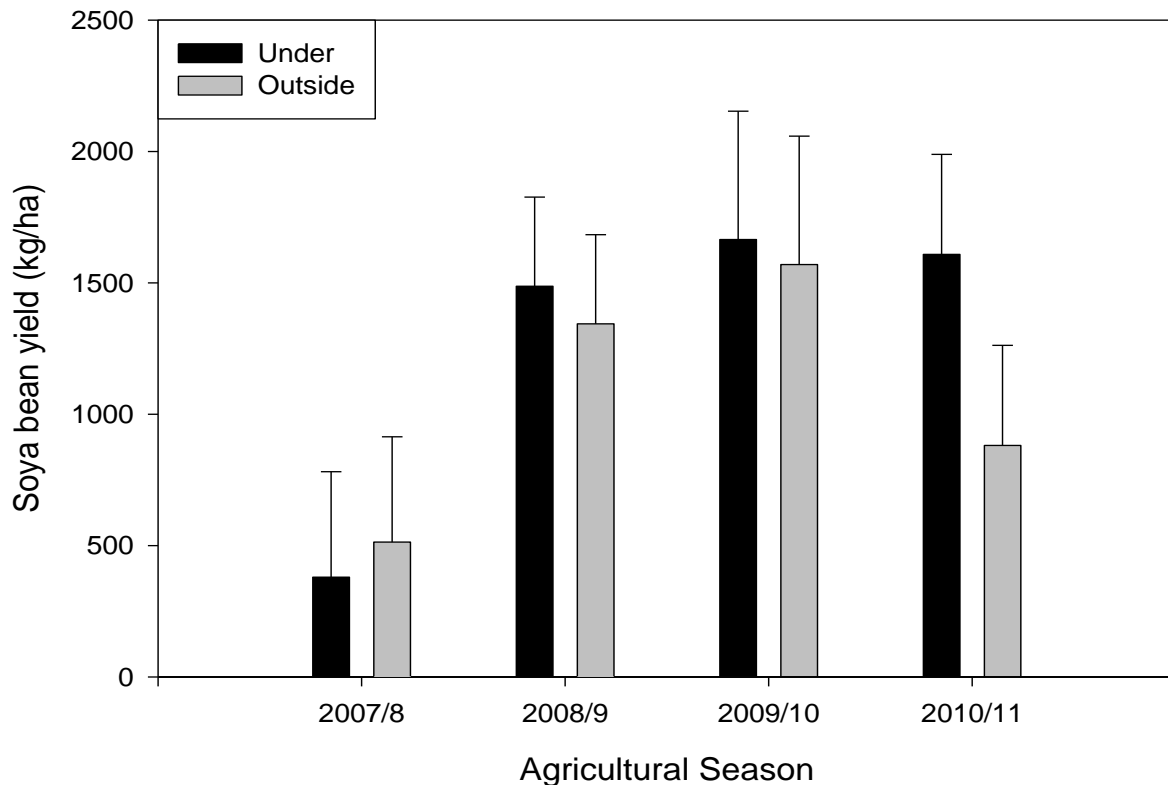


Figure 6. Mean yields of soya beans under and outside canopies of *Faidherbia albida* over four seasons

There were no statistically significant differences between the yields of soya bean grown in plots outside and under canopies of *Faidherbia albida* during the first three years of trials. However in the fourth year of trials, soya bean yields from plots under canopies of *Faidherbia albida* were significantly higher than those from plots outside the canopies.

GENERAL DISCUSSION OF CROP YIELD TRENDS OVER FOUR YEAR PERIOD

The foregoing results on the trends in the yields of maize, groundnuts and soya beans show a common pattern of a progressive increase in yield from the first year of cultivation to the third year. After the third season the yields either stabilized or rapidly declined. It seems that crop rotations under canopies of *Faidherbia albida* results in a significant increase in the yields of maize, soya bean and groundnuts in the first three years of cultivations, but yields either stabilize or begin declining after the third year if there is no replenishment of plant nutrients. A similar pattern is observed for crops grown in rotations outside canopies of *Faidherbia albida*. Yields of maize and soya beans from the plots outside the canopies of *Faidherbia albida* were generally lower than those from plots under canopies of *Faidherbia albida*, indicating that the fertility levels of soils under the *Faidherbia* trees is higher than that of soils outside canopies of *Faidherbia albida*.

The trend in the yields of cotton is different from that observed for maize, groundnuts, and soya beans. Cotton yields progressively declined from the first year through to the fourth year of cultivation. In addition, cotton yield levels under the canopies of *Faidherbia albida* were generally lower than those outside the canopies.

CONCLUSIONS AND RECOMMENDATIONS

The Conservation Farming Unit carried out crop trials in Zambia to assess the effects of *Faidherbia albida* on crop yields grown in rotation involving cotton groundnuts maize and soya beans over four agricultural seasons with no application of fertilizer. The trials were initiated in the 2007/2008 agricultural season and concluded in the 2010/2011 agricultural season.

Results of the crop trials conducted by the CFU to demonstrate the yield benefits of growing crops under canopies of mature *Faidherbia albida* trees have shown that yields of maize grown under canopies of *Faidherbia albida* were significantly higher than those of maize grown outside canopies in all the four regions of Zambia where the trials were conducted and in the four agricultural seasons during which the trials were conducted. The average yield of maize under the canopies of *Faidherbia albida* was about 5.0 metric tonnes per hectare compared to an average of about 2.0 metric per hectare for maize grown outside canopies of *Faidherbia albida*. No statistically significant differences were observed between yields of cotton, soya bean and groundnuts grown under and outside canopies of *Faidherbia albida*.

Trends in the yields of maize, soya bean and groundnuts grown both under and outside canopies of *Faidherbia albida* showed a progressive increase from the first to third year of cultivation after which the yields either remained constant or began declining. In contrast, the yield of cotton showed a progressive decline from the first year of cultivation through to the fourth year of cultivation. The results of the trials indicate that maize, soya beans and groundnuts can sustainably be grown in rotation under canopies of *Faidherbia albida* for a period of three year without applying chemical fertilizers under small holder farmer conditions in Agro-ecological region II of Zambia.

Results of these trials have clearly demonstrated the benefits of growing maize under canopies of mature *Faidherbia albida* trees in a crop rotation with legumes. The trials have also demonstrated the benefits of growing crops in rotation on sustaining the productivity of the land as all the crops grown except cotton. Maize is the crop that showed the greatest benefits to being grown under canopies of *Faidherbia albida*, followed by soya beans. Cotton and groundnuts do not seem to produce good yields under canopies of *Faidherbia albida* and therefore may not be the right crops to grow under these trees. Cotton does not appear to be suitable for cultivation under canopies of *Faidherbia albida*.

LIST OF APPENDICES

APPENDIX 1.0 CROP YIELDS DATA FOR PLOTS OUTSIDE AND UNDER CANOPIES OF THE MUSANGU TREE FOR THE CENTRAL REGION IN THE 2010/2011 CROP SEASON.

Obs	Region	Farmer	Crop	Treat	Yield/plot	Yield(kg/ha)
1	Central	Joyce Mulimbika	Maize	Under	43.0	5688
2	Central	Silvia Sikagoma	Maize	Under	25.0	3307
3	Central	Florence Kalumbi	Maize	Under	22.5	2976
4	Central	Moses Simwenge	Maize	Under	25.0	3307
5	Central	Martin S. Njovu	Maize	Under	50.0	6614
6	Central	Sarah Mwakalombe	Maize	Under	43.5	5754
7	Central	David Mabingo	Maize	Under	46.0	6085
8	Central	Betty Switi	Maize	Under	58.5	7738
9	Central	Lapson Munyeke	Maize	Under	49.0	6481
10	Central	Edward Malupande	Maize	Under	56.5	7474
11	Central	Joyce Mulimbika	Maize	Outside	25.0	3307
12	Central	Silvia Sikagoma	Maize	Outside	11.0	1455
13	Central	Florence Kalumbi	Maize	Outside	17.5	2315
14	Central	Moses Simwenge	Maize	Outside	28.0	3704
15	Central	Martin S. Njovu	Maize	Outside	46.0	6085
16	Central	Sarah Mwakalombe	Maize	Outside	20.0	2646
17	Central	David Mabingo	Maize	Outside	23.0	3042
18	Central	Betty Switi	Maize	Outside	42.0	5556
19	Central	Lapson Munyeke	Maize	Outside	23.0	3042
20	Central	Edward Malupande	Maize	Outside	34.0	4497
21	Central	Joyce Mulimbika	Cotton	Under	0.5	66
22	Central	Silvia Sikagoma	Cotton	Under	9.5	1257
23	Central	Florence Kalumbi	Cotton	Under	8.5	1124
24	Central	Moses Simwenge	Cotton	Under	9.0	1190
25	Central	Martin S. Njovu	Cotton	Under	5.5	728
26	Central	Sarah Mwakalombe	Cotton	Under	7.5	992
27	Central	David Mabingo	Cotton	Under	1.0	132
28	Central	Betty Switi	Cotton	Under	5.0	661
29	Central	Lapson Munyeke	Cotton	Under	5.0	661
30	Central	Edward Malupande	Cotton	Under	5.0	661
31	Central	Joyce Mulimbika	Cotton	Outside	6.0	794
32	Central	Silvia Sikagoma	Cotton	Outside	5.5	728
33	Central	Florence Kalumbi	Cotton	Outside	5.5	728
34	Central	Moses Simwenge	Cotton	Outside	14.0	1852
35	Central	Martin S. Njovu	Cotton	Outside	21.0	2778
36	Central	Sarah Mwakalombe	Cotton	Outside	15.0	1984
37	Central	David Mabingo	Cotton	Outside	2.5	331
38	Central	Betty Switi	Cotton	Outside	12.0	1587
39	Central	Lapson Munyeke	Cotton	Outside	4.0	529
40	Central	Edward Malupande	Cotton	Outside	13.5	1786
41	Central	Joyce Mulimbika	Groundnut	Under	1.0	132
42	Central	Silvia Sikagoma	Groundnut	Under	4.5	595
43	Central	Florence Kalumbi	Groundnut	Under	3.0	397
44	Central	Moses Simwenge	Groundnut	Under	2.0	265
45	Central	Martin S. Njovu	Groundnut	Under	6.5	860
46	Central	Sarah Mwakalombe	Groundnut	Under	6.0	794
47	Central	David Mabingo	Groundnut	Under	1.0	132
48	Central	Betty Switi	Groundnut	Under	2.0	265
49	Central	Lapson Munyeke	Groundnut	Under	4.5	595
50	Central	Edward Malupande	Groundnut	Under	2.0	265
51	Central	Joyce Mulimbika	Groundnut	Outside	3.0	397
52	Central	Silvia Sikagoma	Groundnut	Outside	2.0	265

Obs	Region	Farmer	Crop	Treat	Yield	fyield
53	Central	Florence Kalumbi	Groundnut	Outside	4.0	529
54	Central	Moses Simwenge	Groundnut	Outside	3.0	397
55	Central	Martin S. Njovu	Groundnut	Outside	13.5	1786
56	Central	Sarah Mwakalombe	Groundnut	Outside	4.5	595
57	Central	David Mabingo	Groundnut	Outside	4.0	529
58	Central	Betty Switi	Groundnut	Outside	6.0	794
59	Central	Lapson Munyeke	Groundnut	Outside	5.0	661
60	Central	Edward Malupande	Groundnut	Outside	4.5	595
61	Central	Joyce Mulimbika	Soyabean	Under	16.0	2116
62	Central	Silvia Sikagoma	Soyabean	Under	11.0	1455
63	Central	Florence Kalumbi	Soyabean	Under	20.0	2646
64	Central	Moses Simwenge	Soyabean	Under	11.5	1521
65	Central	Martin S. Njovu	Soyabean	Under	22.5	2976
66	Central	Sarah Mwakalombe	Soyabean	Under	12.5	1653
67	Central	David Mabingo	Soyabean	Under	14.5	1918
68	Central	Betty Switi	Soyabean	Under	12.5	1653
69	Central	Lapson Munyeke	Soyabean	Under	21.0	2778
70	Central	Edward Malupande	Soyabean	Under	14.0	1852
71	Central	Joyce Mulimbika	Soyabean	Outside	10.5	1389
72	Central	Silvia Sikagoma	Soyabean	Outside	11.0	1455
73	Central	Florence Kalumbi	Soyabean	Outside	9.0	1190
74	Central	Moses Simwenge	Soyabean	Outside	9.0	1190
75	Central	Martin S. Njovu	Soyabean	Outside	13.5	1786
76	Central	Sarah Mwakalombe	Soyabean	Outside	1.0	132
77	Central	David Mabingo	Soyabean	Outside	6.5	860
78	Central	Betty Switi	Soyabean	Outside	12.0	1587
79	Central	Lapson Munyeke	Soyabean	Outside	2.0	265
80	Central	Edward Malupande	Soyabean	Outside	1.5	198

APPENDIX 1.1 AVERAGE CROP YIELDS UNDER AND OUTSIDE CANOPIES OF FAIDHERBIA ALBIDA FOR THE CENTRAL REGION IN THE 2010/2011 AGRICULTURAL SEASON.

Crop	Location	Sites	Mean Yield (kg/ha)
Cotton	Outside	10	1309.70
	Under	10	747.20
Groundnut	Outside	10	654.80
	Under	10	430.00
Maize	Outside	10	3564.90
	Under	10	5542.40
Soyabean	Outside	10	1005.20
	Under	10	2056.80

APPENDIX 1.2.0 ANALYSIS OF VARIANCE TABLE FOR COTTON YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE CENTRAL REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under
Number of observations		20

The GLM Procedure

Dependent Variable: Cotton Yield (kg/ha)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1582031.250	1582031.250	3.93	0.0628
Error	18	7241511.700	402306.206		
Corrected Total	19	8823542.950			

R-Square	Coeff Var	Root MSE	fyield Mean
0.179297	61.67302	634.2761	1028.450

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	1582031.250	1582031.250	3.93	0.0628

APPENDIX 1.2.1 T-TEST FOR COMPARING COTTON YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE WESTERN REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	18
Error Mean Square	402306.2
Critical Value of t	2.10092
Least Significant Difference	595.94

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	1309.7	10	Outside
A	747.2	10	Under

APPENDIX 1.3.0 ANALYSIS OF VARIANCE TABLE FOR GROUNDNUT YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE CENTRAL REGION IN THE 2010/2011 SEASON

Class Level Information

Class	Levels	Values
Treat	2	Outside Under

Number of observations 20

The GLM Procedure

Dependent Variable: Groundnut Yield (kg/ha)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	252675.200	252675.200	2.02	0.1726
Error	18	2254915.600	125273.089		
Corrected Total	19	2507590.800			

R-Square	Coeff Var	Root MSE	fyield Mean
0.100764	65.25431	353.9394	542.4000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	252675.2000	252675.2000	2.02	0.1726

APPENDIX 1.3.1 T-TEST FOR COMPARING GROUNDNUT YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE CENTRAL REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	18
Error Mean Square	125273.1
Critical Value of t	2.10092
Least Significant Difference	332.55

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	654.8	10	Outside
A			
A	430.0	10	Under

APPENDIX 1.4.0 ANALYSIS OF VARIANCE TABLE FOR MAIZE YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE CENTRAL REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under

Number of observations 20

Dependent Variable: Maize Yield (kg/ha)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	19552531.25	19552531.25	7.62	0.0129
Error	18	46197067.30	2566503.74		
Corrected Total	19	65749598.55			

R-Square	Coeff Var	Root MSE	fyield Mean
0.297379	35.18125	1602.031	4553.650

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	19552531.25	19552531.25	7.62	0.0129

APPENDIX 1.4.1 T-TEST FOR COMPARING MAIZE YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE CENTRAL REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	18
Error Mean Square	2566504
Critical Value of t	2.10092
Least Significant Difference	1505.2

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	5542.4	10	Under
B	3564.9	10	Outside

APPENDIX 1.5.0 ANALYSIS OF VARIANCE TABLE FOR SOYA BEAN YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE CENTRAL REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under

Number of observations 20

The GLM Procedure

Dependent Variable: Soya bean Yield (kg/ha)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	5529312.80	5529312.80	16.31	0.0008
Error	18	6101375.20	338965.29		
Corrected Total	19	11630688.00			

R-Square	Coeff Var	Root MSE	fyield Mean
0.475407	38.02791	582.2073	1531.000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	5529312.800	5529312.800	16.31	0.0008

APPENDIX 1.5.1 T-TEST FOR COMPARING SOYA BEAN YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE CENTRAL REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	18
Error Mean Square	338965.3
Critical Value of t	2.10092
Least Significant Difference	547.02

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	2056.8	10	Under
B	1005.2	10	Outside

APPENDIX 2.0. CROP YIELDS DATA FOR PLOTS OUTSIDE AND UNDER CANOPIES OF THE MUSANGU TREES FOR THE SOUTHERN REGION IN THE 2010/2011 CROP SEASON.

Obs	Region	Farmer	Crop	Treat	Yield(kg/ha)
1	Southern	Asset Muzandu	Maize	Under	8201
2	Southern	Stella Siwale	Maize	Under	8201
3	Southern	Timmy Mwela	Maize	Under	5688
4	Southern	Sara Mulongo	Maize	Under	2778
5	Southern	Gift Hamufuwa	Maize	Under	6878
6	Southern	Mainza Maxwell	Maize	Under	7143
7	Southern	Mainza Maxwell	Maize	Under	5952
8	Southern	Judith Hamayuwa	Maize	Under	5688
9	Southern	Kalimamusonde	Maize	Under	3836
10	Southern	Asset Muzandu	Maize	Outside	794
11	Southern	Stella Siwale	Maize	Outside	7143
12	Southern	Timmy Mwela	Maize	Outside	3175
13	Southern	Sara Mulongo	Maize	Outside	529
14	Southern	Gift Hamufuwa	Maize	Outside	1455
15	Southern	Mainza Maxwell	Maize	Outside	6085
16	Southern	Mainza Maxwell	Maize	Outside	4630
17	Southern	Judith Hamayuwa	Maize	Outside	1984
18	Southern	Kalimamusonde	Maize	Outside	1455
19	Southern	Asset Muzandu	Cotton	Under	0
20	Southern	Stella Siwale	Cotton	Under	2249
21	Southern	Timmy Mwela	Cotton	Under	529
22	Southern	Sara Mulongo	Cotton	Under	463
23	Southern	Gift Hamufuwa	Cotton	Under	198
24	Southern	Mainza Maxwell	Cotton	Under	661
25	Southern	Mainza Maxwell	Cotton	Under	992
26	Southern	Judith Hamayuwa	Cotton	Under	1058
27	Southern	Kalimamusonde	Cotton	Under	1455
28	Southern	Asset Muzandu	Cotton	Outside	0
29	Southern	Stella Siwale	Cotton	Outside	2513
30	Southern	Timmy Mwela	Cotton	Outside	926
31	Southern	Sara Mulongo	Cotton	Outside	132
32	Southern	Gift Hamufuwa	Cotton	Outside	331
33	Southern	Mainza Maxwell	Cotton	Outside	1058
34	Southern	Mainza Maxwell	Cotton	Outside	1257
35	Southern	Judith Hamayuwa	Cotton	Outside	1587
36	Southern	Kalimamusonde	Cotton	Outside	860
37	Southern	Asset Muzandu	Soyabean	Under	1455
38	Southern	Stella Siwale	Soyabean	Under	3307
39	Southern	Timmy Mwela	Soyabean	Under	1058
40	Southern	Sara Mulongo	Soyabean	Under	1323
41	Southern	Gift Hamufuwa	Soyabean	Under	1720
42	Southern	Mainza Maxwell	Soyabean	Under	2712
43	Southern	Mainza Maxwell	Soyabean	Under	1389
44	Southern	Judith Hamayuwa	Soyabean	Under	4101
45	Southern	Kalimamusonde	Soyabean	Under	1389
46	Southern	Asset Muzandu	Soyabean	Outside	529
47	Southern	Stella Siwale	Soyabean	Outside	3704
48	Southern	Timmy Mwela	Soyabean	Outside	926
49	Southern	Sara Mulongo	Soyabean	Outside	132
50	Southern	Gift Hamufuwa	Soyabean	Outside	926
51	Southern	Mainza Maxwell	Soyabean	Outside	1455
52	Southern	Mainza Maxwell	Soyabean	Outside	728

Obs	Region	Farmer	Crop	Treat	Yield (kg/ha)
53	Southern	Judith Hamayuwa	Soyabean	Outside	1455
54	Southern	Kalimamusonde	Soyabean	Outside	1323
55	Southern	Asset Muzandu	Groundnut	Under	1455
56	Southern	Stella Siwale	Groundnut	Under	529
57	Southern	Timmy Mwela	Groundnut	Under	463
58	Southern	Sara Mulongo	Groundnut	Under	397
59	Southern	Gift Hamufuwa	Groundnut	Under	397
60	Southern	Mainza Maxwell	Groundnut	Under	1389
61	Southern	Mainza Maxwell	Groundnut	Under	1455
62	Southern	Judith Hamayuwa	Groundnut	Under	397
63	Southern	Kalimamusonde	Groundnut	Under	265
64	Southern	Asset Muzandu	Groundnut	Outside	1058
65	Southern	Stella Siwale	Groundnut	Outside	661
66	Southern	Timmy Mwela	Groundnut	Outside	1323
67	Southern	Sara Mulongo	Groundnut	Outside	66
68	Southern	Gift Hamufuwa	Groundnut	Outside	132
69	Southern	Mainza Maxwell	Groundnut	Outside	2116
70	Southern	Mainza Maxwell	Groundnut	Outside	1984
71	Southern	Judith Hamayuwa	Groundnut	Outside	794
72	Southern	Kalimamusonde	Groundnut	Outside	265

APPENDIX 2.1 AVERAGE CROP YIELDS UNDER AND OUTSIDE CANOPIES OF FAIDHERBIA ALBIDA FOR THE SOUTHERN REGION IN THE 2010/2011 AGRICULTURAL SEASON.

Crop	Treat	N Site	Mean Yield(kg/ha)
Cotton	Outside	9	962.67
	Under	9	845.00
Groundnut	Outside	9	933.22
	Under	9	749.67
Maize	Outside	9	3027.78
	Under	9	6040.56
Soyabean	Outside	9	1242.00
	Under	9	2050.44

APPENDIX 2.2.0 ANALYSIS OF VARIANCE TABLE FOR COTTON YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE SOUTHERN REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under
Number of observations		18

The GLM Procedure

Dependent Variable: COTTON Yield(kg/ha)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	62304.500	62304.500	0.11	0.7399
Error	16	8739232.000	546202.000		
Corrected Total	17	8801536.500			

R-Square	Coeff Var	Root MSE	fyield Mean
0.007079	81.76893	739.0548	903.8333

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	62304.50000	62304.50000	0.11	0.7399

APPENDIX 2.2.1 T-TEST FOR COMPARING COTTON YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE SOUTHERN REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	546202
Critical Value of t	2.11991
Least Significant Difference	738.56

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	962.7	9	Outside
A	845.0	9	Under

APPENDIX 2.3.0 ANALYSIS OF VARIANCE TABLE FOR GROUNDNUT YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE SOUTHERN REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under

Number of observations 18

Dependent Variable: Groundnut yield

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	151616.889	151616.889	0.36	0.5572
Error	16	6747265.556	421704.097		
Corrected Total	17	6898882.444			

R-Square	Coeff Var	Root MSE	fyield Mean
0.021977	77.17532	649.3875	841.4444

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	151616.8889	151616.8889	0.36	0.5572

APPENDIX 2.3.1 T-TEST FOR COMPARING GROUNDNUTS YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE SOUTHERN REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	421704.1
Critical Value of t	2.11991
Least Significant Difference	648.95

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	933.2	9	Outside
A	749.7	9	Under

APPENDIX 2.4.0 ANALYSIS OF VARIANCE TABLE FOR MAIZE YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE SOUTHERN REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under

Number of observations 18

Dependent Variable: Maize Yield

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	40845734.7	40845734.7	8.93	0.0087
Error	16	73153341.8	4572083.9		
Corrected Total	17	113999076.5			

R-Square	Coeff Var	Root MSE	Yield Mean
0.358299	47.15846	2138.243	4534.167

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	40845734.72	40845734.72	8.93	0.0087

APPENDIX 2.4.1 T-TEST FOR COMPARING MAIZE YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE SOUTHERN REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	4572084
Critical Value of t	2.11991
Least Significant Difference	2136.8

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	6041	9	Under
B	3028	9	Outside

APPENDIX 2.5.0 ANALYSIS OF VARIANCE TABLE FOR SOYA BEAN YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE SOUTHERN REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under
Number of observations		18

The GLM Procedure

Dependent Variable: Soya beans yield

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	2941120.89	2941120.89	2.70	0.1199
Error	16	17437372.22	1089835.76		
Corrected Total	17	20378493.11			

R-Square	Coeff Var	Root MSE	Yield Mean
0.144325	63.41501	1043.952	1646.222

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	2941120.889	2941120.889	2.70	0.1199

APPENDIX 2.5.1 T-TEST FOR COMPARING SOYA BEAN YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE SOUTHERN REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	1089836
Critical Value of t	2.11991
Least Significant Difference	1043.3

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	2050.4	9	Under
A			
A	1242.0	9	Outside

**APPENDIX 3.0 CROP YIELD DATA FOR PLOTS OUTSIDE AND UNDER CANOPIES OF THE MUSANGU TREE IN THE
EASTERN REGION FOR THE 2010/2011 CROP SEASON.**

Obs	Region	Site	Crop	Treat	Yield (kg/ha)
1	Eastern	1	Maize	Under	5159
2	Eastern	1	Cotton	Under	1852
3	Eastern	1	Groundnut	Under	661
4	Eastern	1	Soyabean	Under	1786
5	Eastern	2	Maize	Under	4233
6	Eastern	2	Cotton	Under	1772
7	Eastern	2	Groundnut	Under	661
8	Eastern	2	Soyabean	Under	926
9	Eastern	3	Maize	Under	4497
10	Eastern	3	Cotton	Under	2302
11	Eastern	3	Groundnut	Under	661
12	Eastern	3	Soyabean	Under	899
13	Eastern	4	Maize	Under	3836
14	Eastern	4	Cotton	Under	992
15	Eastern	4	Groundnut	Under	992
16	Eastern	4	Soyabean	Under	1455
17	Eastern	5	Maize	Under	3704
18	Eastern	5	Cotton	Under	1455
19	Eastern	5	Groundnut	Under	265
20	Eastern	5	Soyabean	Under	992
21	Eastern	6	Maize	Under	4365
22	Eastern	6	Cotton	Under	1984
23	Eastern	6	Groundnut	Under	701
24	Eastern	6	Soyabean	Under	529
25	Eastern	1	Maize	Outside	1786
26	Eastern	1	Cotton	Outside	2778
27	Eastern	1	Groundnut	Outside	529
28	Eastern	1	Soyabean	Outside	331
29	Eastern	2	Maize	Outside	3373
30	Eastern	2	Cotton	Outside	2249
31	Eastern	2	Groundnut	Outside	926
32	Eastern	2	Soyabean	Outside	331
33	Eastern	3	Maize	Outside	1270
34	Eastern	3	Cotton	Outside	2328
35	Eastern	3	Groundnut	Outside	1085
36	Eastern	3	Soyabean	Outside	529
37	Eastern	4	Maize	Outside	2116
38	Eastern	4	Cotton	Outside	1587
39	Eastern	4	Groundnut	Outside	794
40	Eastern	4	Soyabean	Outside	767
41	Eastern	5	Maize	Outside	2831
42	Eastern	5	Cotton	Outside	1786
43	Eastern	5	Groundnut	Outside	331
44	Eastern	5	Soyabean	Outside	926
45	Eastern	6	Maize	Outside	2910
46	Eastern	6	Cotton	Outside	2381
47	Eastern	6	Groundnut	Outside	794
48	Eastern	6	Soyabean	Outside	714
49	Eastern	7	Maize	Under	7143
50	Eastern	7	Groundnut	Under	1323
51	Eastern	7	Soyabean	Under	4233
52	Eastern	7	Cotton	Under	2513

53	Eastern	8	Maize	Under	8466
54	Eastern	8	Groundnut	Under	1190
55	Eastern	8	Soyabean	Under	4894
56	Eastern	8	Cotton	Under	2381
57	Eastern	7	Maize	Outside	2778
58	Eastern	7	Groundnut	Outside	1455
59	Eastern	7	Soyabean	Outside	1984
60	Eastern	7	Cotton	Outside	926
61	Eastern	8	Maize	Outside	2381
62	Eastern	8	Groundnut	Outside	1587
63	Eastern	8	Soyabean	Outside	2910
64	Eastern	8	Cotton	Outside	926
65	Eastern	9	Maize	Under	2249
66	Eastern	9	Groundnut	Under	1058
67	Eastern	9	Sunflowe	Under	992
68	Eastern	9	Soyabean	Under	1984
69	Eastern	10	Maize	Under	4762
70	Eastern	10	Groundnut	Under	1190
71	Eastern	10	Cotton	Under	384
72	Eastern	10	Soyabean	Under	701
73	Eastern	11	Maize	Under	3307
74	Eastern	11	Groundnut	Under	119
75	Eastern	11	Soyabean	Under	423
76	Eastern	11	Cotton	Under	53
77	Eastern	9	Maize	Outside	1455
78	Eastern	9	Groundnut	Outside	1455
79	Eastern	9	Sunflowe	Outside	661
80	Eastern	9	Soyabean	Outside	1058
81	Eastern	10	Maize	Outside	1323
82	Eastern	10	Groundnut	Outside	820
83	Eastern	10	Cotton	Outside	542
84	Eastern	10	Soyabean	Outside	635
85	Eastern	11	Maize	Outside	423
86	Eastern	11	Groundnut	Outside	40
87	Eastern	11	Soyabean	Outside	265
88	Eastern	11	Cotton	Outside	278

APPENDIX 3.1 AVERAGE CROP YIELDS UNDER AND OUTSIDE CANOPIES OF FAIDHERBIA ALBIDA FOR THE EASTERN REGION IN THE 2010/2011 AGRICULTURAL SEASON.

Crop	Location	Sites	Mean Yield (kg/ha)
Cotton	Outside	10	1578.10
	Under	10	1568.80
Groundnut	Outside	11	892.36
	Under	11	801.91
Maize	Outside	11	2058.73
	Under	11	4701.91
Soyabean	Outside	11	950.00
	Under	11	1711.09
Sunflowe	Outside	1	661.00

Under	1	992.00
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APPENDIX 3.2.0 ANALYSIS OF VARIANCE TABLE FOR COTTON YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE EASTERN REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under

Number of observations 20

Dependent Variable: Cotton Yield (kg/ha)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	432.45	432.45	0.00	0.9809
Error	18	13184096.50	732449.81		
Corrected Total	19	13184528.95			

R-Square	Coeff Var	Root MSE	fyield Mean
0.000033	54.39212	855.8328	1573.450

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	432.4500000	432.4500000	0.00	0.9809

APPENDIX 3.2.1 T-TEST FOR COMPARING COTTON YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE EASTERN REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	18
Error Mean Square	732449.8
Critical Value of t	2.10092
Least Significant Difference	804.11

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	1578.1	10	Outside
A			
A	1568.8	10	Under

APPENDIX 3.3 0 ANALYSIS OF VARIANCE TABLE FOR GROUNDNUT YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE EASTERN REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under

Number of observations 22

Dependent Variable: Groundnut Yield (kg/ha)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	45001.136	45001.136	0.23	0.6340
Error	20	3851019.455	192550.973		
Corrected Total	21	3896020.591			

R-Square	Coeff Var	Root MSE	Yield Mean
0.011551	51.79878	438.8063	847.1364

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	45001.13636	45001.13636	0.23	0.6340

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Treat	1	45001.13636	45001.13636	0.23	0.6340

APPENDIX 3.3.1 T-TEST FOR COMPARING GROUNDNUT YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE EASTERN REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	20
Error Mean Square	192551
Critical Value of t	2.08596
Least Significant Difference	390.3

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	892.4	11	Outside
A			
A	801.9	11	Under

APPENDIX 3.4.0 ANALYSIS OF VARIANCE TABLE FOR MAIZE YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE EASTERN REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under

Number of observations 22

Dependent Variable: Maize Yield (kg/ha)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	38425255.68	38425255.68	20.03	0.0002
Error	20	38374107.09	1918705.35		
Corrected Total	21	76799362.77			

R-Square	Coeff Var	Root MSE	fyield Mean
0.500333	40.97760	1385.173	3380.318

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	38425255.68	38425255.68	20.03	0.0002

APPENDIX 3.4.1 T-TEST FOR COMPARING SOYA BEAN YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE WESTERN REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	20
Error Mean Square	1918705
Critical Value of t	2.08596
Least Significant Difference	1232.1

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	4701.9	11	Under
B	2058.7	11	Outside

APPENDIX 3.5.0 ANALYSIS OF VARIANCE TABLE FOR SOYA BEAN YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE EASTERN REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under
Number of observations		22

Dependent Variable: Soya bean Yield (kg/ha)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	3185926.55	3185926.55	2.19	0.1541
Error	20	29030554.91	1451527.75		
Corrected Total	21	32216481.45			

R-Square	Coeff Var	Root MSE	Yield Mean
0.098891	90.54885	1204.794	1330.545

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	3185926.545	3185926.545	2.19	0.1541

APPENDIX 3.5.1 T-TEST FOR COMPARING SOYA BEAN YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE EASTERN REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	20
Error Mean Square	1451528
Critical Value of t	2.08596
Least Significant Difference	1071.6

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	1711.1	11	Under
A	950.0	11	Outside

**APPENDIX 4.0 CROP YIELDS OUTSIDE AND UNDER CANOPIES OF THE MUSANGU TREE IN THE WESTERN REGION
FOR THE 2010/2011 CROP SEASON.**

Obs	Region	Farmer	Crop	Treat	Yield
1	Western	Shamamba Evans	Maize	Under	5754
2	Western	Shamabanse Nixon	Maize	Under	2646
3	Western	Malasha Spencer	Maize	Under	5952
4	Western	Chiwaya Saviors	Maize	Under	2513
5	Western	Muzondiwa Shalai	Maize	Under	5159
6	Western	Mulumbi Richard	Maize	Under	4365
7	Western	Muzungu Nelson	Maize	Under	4894
8	Western	Mweemba Dorcus	Maize	Under	3307
9	Western	Kafwabwe Lindah	Maize	Under	9788
10	Western	Sikacheya Linah	Maize	Under	8201
11	Western	Shamamba Evans	Maize	Outside	4299
12	Western	Shamabanse Nixon	Maize	Outside	1257
13	Western	Malasha Spencer	Maize	Outside	4630
14	Western	Chiwaya Saviors	Maize	Outside	2778
15	Western	Muzungu Nelson	Maize	Outside	767
16	Western	Mweemba Dorcus	Maize	Outside	728
17	Western	Kafwabwe Lindah	Maize	Outside	5291
18	Western	Sikacheya Linah	Maize	Outside	5952
19	Western	Shamamba Evans	Cotton	Under	860
20	Western	Shamabanse Nixon	Cotton	Under	463
21	Western	Malasha Spencer	Cotton	Under	.
22	Western	Chiwaya Saviors	Cotton	Under	132
23	Western	Muzondiwa Shalai	Cotton	Under	1587
24	Western	Mulumbi Richard	Cotton	Under	1124
25	Western	Muzungu Nelson	Cotton	Under	529
26	Western	Mweemba Dorcus	Cotton	Under	265
27	Western	Kafwabwe Lindah	Cotton	Under	.
28	Western	Sikacheya Linah	Cotton	Under	.
29	Western	Shamamba Evans	Cotton	Outside	2050
30	Western	Shamabanse Nixon	Cotton	Outside	728
31	Western	Malasha Spencer	Cotton	Outside	.
32	Western	Chiwaya Saviors	Cotton	Outside	265
33	Western	Muzondiwa Shalai	Cotton	Outside	463
34	Western	Mulumbi Richard	Cotton	Outside	1058
35	Western	Muzungu Nelson	Cotton	Outside	265
36	Western	Mweemba Dorcus	Cotton	Outside	265
37	Western	Kafwabwe Lindah	Cotton	Outside	.
38	Western	Sikacheya Linah	Cotton	Outside	.
39	Western	Shamamba Evans	Groundnut	Under	265
40	Western	Shamabanse Nixon	Groundnut	Under	291
41	Western	Malasha Spencer	Groundnut	Under	198
42	Western	Chiwaya Saviors	Groundnut	Under	132
43	Western	Muzondiwa Shalai	Groundnut	Under	529
44	Western	Mulumbi Richard	Groundnut	Under	397
45	Western	Muzungu Nelson	Groundnut	Under	265
46	Western	Mweemba Dorcus	Groundnut	Under	198
47	Western	Kafwabwe Lindah	Groundnut	Under	.
48	Western	Sikacheya Linah	Groundnut	Under	.
49	Western	Shamamba Evans	Groundnut	Outside	595
50	Western	Shamabanse Nixon	Groundnut	Outside	661
51	Western	Malasha Spencer	Groundnut	Outside	265
52	Western	Chiwaya Saviors	Groundnut	Outside	238

CROP YIELDS OUTSIDE AND UNDER CANOPIES OF THE MUSANGU TREE IN THE WESTERN
REGION FOR THE 2010/2011 CROP SEASON.

Obs	Region	Farmer	Crop	Treat	Yield
53	Western	Muzondiwa Shalai	Groundnut	Outside	331
54	Western	Mulumbi Richard	Groundnut	Outside	331
55	Western	Muzungu Nelson	Groundnut	Outside	397
56	Western	Mweemba Dorcus	Groundnut	Outside	265
57	Western	Kafwabwe Lindah	Groundnut	Outside	.
58	Western	Sikacheya Linah	Groundnut	Outside	.
59	Western	Shamamba Evans	Soyabean	Under	1323
60	Western	Shamabanse Nixon	Soyabean	Under	1257
61	Western	Malasha Spencer	Soyabean	Under	1058
62	Western	Chiwaya Saviors	Soyabean	Under	132
63	Western	Muzondiwa Shalai	Soyabean	Under	.
64	Western	Mulumbi Richard	Soyabean	Under	1190
65	Western	Muzungu Nelson	Soyabean	Under	198
66	Western	Mweemba Dorcus	Soyabean	Under	794
67	Western	Kafwabwe Lindah	Soyabean	Under	.
68	Western	Sikacheya Linah	Soyabean	Under	.
69	Western	Shamamba Evans	Soyabean	Outside	1918
70	Western	Shamabanse Nixon	Soyabean	Outside	1323
71	Western	Malasha Spencer	Soyabean	Outside	.
72	Western	Chiwaya Saviors	Soyabean	Outside	265
73	Western	Muzondiwa Shalai	Soyabean	Outside	.
74	Western	Mulumbi Richard	Soyabean	Outside	198
75	Western	Muzungu Nelson	Soyabean	Outside	132
76	Western	Mweemba Dorcus	Soyabean	Outside	265
77	Western	Kafwabwe Lindah	Soyabean	Outside	.
78	Western	Sikacheya Linah	Soyabean	Outside	.

**APPENDIX 4.1 AVERAGE CROP YIELDS UNDER AND OUTSIDE CANOPIES OF FAIDHERBIA ALBIDA FOR THE
WESTERN REGION IN THE 2010/2011 AGRICULTURAL SEASON.**

Crop	Location	N	Mean yield (kg/ha)
Cotton	Outside	10	727.71
	Under	10	708.57
Groundnuts	Outside	10	385.38
	Under	10	284.38
Maize	Outside	8	3212.75
	Under	10	5257.90
Soyabean	Outside	10	683.50
	Under	10	850.29

APPENDIX 4.2.0 ANALYSIS OF VARIANCE TABLE FOR COTTON YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE WESTERN REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under

Number of observations 20

NOTE: Due to missing values, only 14 observations can be used in this analysis.

Dependent Variable: Cotton Yield

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1282.571	1282.571	0.00	0.9525
Error	12	4158805.143	346567.095		
Corrected Total	13	4160087.714			

R-Square	Coeff Var	Root MSE	fyield Mean
0.000308	81.97526	588.6995	718.1429

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	1282.571429	1282.571429	0.00	0.9525

APPENDIX 4.2.1 T-TEST FOR COMPARING COTTON YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE WESTERN REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	346567.1
Critical Value of t	2.17881
Least Significant Difference	685.61

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	727.7	7	Outside
A			
A	708.6	7	Under

APPENDIX 4.3.0 ANALYSIS OF VARIANCE TABLE FOR GROUNDNUT YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE WESTERN REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under

Number of observations 20

NOTE: Due to missing values, only 16 observations can be used in this analysis.

Dependent Variable: f Groundnut Yield

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	40804.0000	40804.0000	1.98	0.1809
Error	14	288119.7500	20579.9821		
Corrected Total	15	328923.7500			

R-Square	Coeff Var	Root MSE	fyield Mean
0.124053	42.83904	143.4572	334.8750

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	40804.00000	40804.00000	1.98	0.1809

APPENDIX 4.3.1 T-TEST FOR COMPARING GROUNDNUT YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE WESTERN REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	14
Error Mean Square	20579.98
Critical Value of t	2.14479
Least Significant Difference	153.84

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	385.38	8	Outside
A			
A	284.38	8	Under

APPENDIX 4.4.0 ANALYSIS OF VARIANCE TABLE FOR MAIZE YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE WESTERN REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under
Number of observations		18

The GLM Procedure

Dependent Variable: Maize yield

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	18589504.54	18589504.54	3.71	0.0721
Error	16	80194308.40	5012144.28		
Corrected Total	17	98783812.94			

R-Square	Coeff Var	Root MSE	Yield Mean
0.188184	51.47874	2238.782	4348.944

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	18589504.54	18589504.54	3.71	0.0721

APPENDIX 4.4.1 T-TEST FOR COMPARING MAIZE YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE WESTERN REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	5012144
Critical Value of t	2.11991
Least Significant Difference	2251.2
Harmonic Mean of Cell Sizes	8.888889

NOTE: Cell sizes are not equal.

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	5258	10	Under
A	3213	8	Outside

APPENDIX 4.5.0 ANALYSIS OF VARIANCE TABLE FOR SOYA BEAN YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE WESTERN REGION IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under
Number of observations		20

NOTE: Due to missing values, only 13 observations can be used in this analysis.

Dependent Variable: Soyabean yield (kg/ha)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	89871.841	89871.841	0.23	0.6416
Error	11	4315102.929	392282.084		
Corrected Total	12	4404974.769			

R-Square	Coeff Var	Root MSE	Yield Mean
0.020402	80.99289	626.3243	773.3077

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	89871.84066	89871.84066	0.23	0.6416

APPENDIX 4.5.1 T-TEST FOR COMPARING SOYA BEAN YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA FOR THE WESTERN REGION IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	11
Error Mean Square	392282.1
Critical Value of t	2.20099
Least Significant Difference	766.94
Harmonic Mean of Cell Sizes	6.461538

NOTE: Cell sizes are not equal.

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	850.3	7	Under

A			
A	683.5	6	Outside

**APPENDIX 5.0 SUMMARY OF CROP YIELD DATA FROM THE FOUR CFU OPERATIONAL REGIONS FOR THE
2010/2011 SEASON**

Obs	Region	Crop	Treat	Yield(kg/ha)
1	Central	Maize	Under	5688
2	Central	Maize	Under	3307
3	Central	Maize	Under	2976
4	Central	Maize	Under	3307
5	Central	Maize	Under	6614
6	Central	Maize	Under	5754
7	Central	Maize	Under	6085
8	Central	Maize	Under	7738
9	Central	Maize	Under	6481
10	Central	Maize	Under	7474
11	Central	Maize	Outside	3307
12	Central	Maize	Outside	1455
13	Central	Maize	Outside	2315
14	Central	Maize	Outside	3704
15	Central	Maize	Outside	6085
16	Central	Maize	Outside	2646
17	Central	Maize	Outside	3042
18	Central	Maize	Outside	5556
19	Central	Maize	Outside	3042
20	Central	Maize	Outside	4497
21	Central	Cotton	Under	66
22	Central	Cotton	Under	1257
23	Central	Cotton	Under	1124
24	Central	Cotton	Under	1190
25	Central	Cotton	Under	728
26	Central	Cotton	Under	992
27	Central	Cotton	Under	132
28	Central	Cotton	Under	661
29	Central	Cotton	Under	661
30	Central	Cotton	Under	661
31	Central	Cotton	Outside	794
32	Central	Cotton	Outside	728
33	Central	Cotton	Outside	728
34	Central	Cotton	Outside	1852
35	Central	Cotton	Outside	2778
36	Central	Cotton	Outside	1984
37	Central	Cotton	Outside	331
38	Central	Cotton	Outside	1587
39	Central	Cotton	Outside	529
40	Central	Cotton	Outside	1786
41	Central	Groundnu	Under	132
42	Central	Groundnu	Under	595
43	Central	Groundnu	Under	397
44	Central	Groundnu	Under	265
45	Central	Groundnu	Under	860
46	Central	Groundnu	Under	794
47	Central	Groundnu	Under	132
48	Central	Groundnu	Under	265
49	Central	Groundnu	Under	595
50	Central	Groundnu	Under	265
51	Central	Groundnu	Outside	397
52	Central	Groundnu	Outside	265

53	Central	Groundnu	Outside	529
54	Central	Groundnu	Outside	397
55	Central	Groundnu	Outside	1786
56	Central	Groundnu	Outside	595
57	Central	Groundnu	Outside	529
58	Central	Groundnu	Outside	794
59	Central	Groundnu	Outside	661
60	Central	Groundnu	Outside	595
61	Central	Soyabean	Under	2116
62	Central	Soyabean	Under	1455
63	Central	Soyabean	Under	2646
64	Central	Soyabean	Under	1521
65	Central	Soyabean	Under	2976
66	Central	Soyabean	Under	1653
67	Central	Soyabean	Under	1918
68	Central	Soyabean	Under	1653
69	Central	Soyabean	Under	2778
70	Central	Soyabean	Under	1852
71	Central	Soyabean	Outside	1389
72	Central	Soyabean	Outside	1455
73	Central	Soyabean	Outside	1190
74	Central	Soyabean	Outside	1190
75	Central	Soyabean	Outside	1786
76	Central	Soyabean	Outside	132
77	Central	Soyabean	Outside	860
78	Central	Soyabean	Outside	1587
79	Central	Soyabean	Outside	265
80	Central	Soyabean	Outside	198
81	Southern	Maize	Under	8201
82	Southern	Maize	Under	8201
83	Southern	Maize	Under	5688
84	Southern	Maize	Under	2778
85	Southern	Maize	Under	6878
86	Southern	Maize	Under	7143
87	Southern	Maize	Under	5952
88	Southern	Maize	Under	5688
89	Southern	Maize	Under	3836
90	Southern	Maize	Outside	794
91	Southern	Maize	Outside	7143
92	Southern	Maize	Outside	3175
93	Southern	Maize	Outside	529
94	Southern	Maize	Outside	1455
95	Southern	Maize	Outside	6085
96	Southern	Maize	Outside	4630
97	Southern	Maize	Outside	1984
98	Southern	Maize	Outside	1455
99	Southern	Cotton	Under	0
100	Southern	Cotton	Under	2249
101	Southern	Cotton	Under	529
102	Southern	Cotton	Under	463
103	Southern	Cotton	Under	198
104	Southern	Cotton	Under	661

105	Southern	Cotton	Under	992
106	Southern	Cotton	Under	1058
107	Southern	Cotton	Under	1455
108	Southern	Cotton	Outside	0
109	Southern	Cotton	Outside	2513
110	Southern	Cotton	Outside	926
111	Southern	Cotton	Outside	132
112	Southern	Cotton	Outside	331
113	Southern	Cotton	Outside	1058
114	Southern	Cotton	Outside	1257
115	Southern	Cotton	Outside	1587
116	Southern	Cotton	Outside	860
117	Southern	Soyabean	Under	1455
118	Southern	Soyabean	Under	3307
119	Southern	Soyabean	Under	1058
120	Southern	Soyabean	Under	1323
121	Southern	Soyabean	Under	1720
122	Southern	Soyabean	Under	2712
123	Southern	Soyabean	Under	1389
124	Southern	Soyabean	Under	4101
125	Southern	Soyabean	Under	1389
126	Southern	Soyabean	Outside	529
127	Southern	Soyabean	Outside	3704
128	Southern	Soyabean	Outside	926
129	Southern	Soyabean	Outside	132
130	Southern	Soyabean	Outside	926
131	Southern	Soyabean	Outside	1455
132	Southern	Soyabean	Outside	728
133	Southern	Soyabean	Outside	1455
134	Southern	Soyabean	Outside	1323
135	Southern	Groundnu	Under	1455
136	Southern	Groundnu	Under	529
137	Southern	Groundnu	Under	463
138	Southern	Groundnu	Under	397
139	Southern	Groundnu	Under	397
140	Southern	Groundnu	Under	1389
141	Southern	Groundnu	Under	1455
142	Southern	Groundnu	Under	397
143	Southern	Groundnu	Under	265
144	Southern	Groundnu	Outside	1058
145	Southern	Groundnu	Outside	661
146	Southern	Groundnu	Outside	1323
147	Southern	Groundnu	Outside	66
148	Southern	Groundnu	Outside	132
149	Southern	Groundnu	Outside	2116
150	Southern	Groundnu	Outside	1984
151	Southern	Groundnu	Outside	794
152	Southern	Groundnu	Outside	265
153	Eastern	Maize	Under	5159
154	Eastern	Cotton	Under	1852
155	Eastern	Groundnu	Under	661
156	Eastern	Soyabean	Under	1786

Obs	Region	Crop	Treat	Yield
157	Eastern	Maize	Under	4233
158	Eastern	Cotton	Under	1772
159	Eastern	Groundnu	Under	661
160	Eastern	Soyabean	Under	926
161	Eastern	Maize	Under	4497
162	Eastern	Cotton	Under	2302
163	Eastern	Groundnu	Under	661
164	Eastern	Soyabean	Under	899
165	Eastern	Maize	Under	3836
166	Eastern	Cotton	Under	992
167	Eastern	Groundnu	Under	992
168	Eastern	Soyabean	Under	1455
169	Eastern	Maize	Under	3704
170	Eastern	Cotton	Under	1455
171	Eastern	Groundnu	Under	265
172	Eastern	Soyabean	Under	992
173	Eastern	Maize	Under	4365
174	Eastern	Cotton	Under	1984
175	Eastern	Groundnu	Under	701
176	Eastern	Soyabean	Under	529
177	Eastern	Maize	Outside	1786
178	Eastern	Cotton	Outside	2778
179	Eastern	Groundnu	Outside	529
180	Eastern	Soyabean	Outside	331
181	Eastern	Maize	Outside	3373
182	Eastern	Cotton	Outside	2249
183	Eastern	Groundnu	Outside	926
184	Eastern	Soyabean	Outside	331
185	Eastern	Maize	Outside	1270
186	Eastern	Cotton	Outside	2328
187	Eastern	Groundnu	Outside	1085
188	Eastern	Soyabean	Outside	529
189	Eastern	Maize	Outside	2116
190	Eastern	Cotton	Outside	1587
191	Eastern	Groundnu	Outside	794
192	Eastern	Soyabean	Outside	767
193	Eastern	Maize	Outside	2831
194	Eastern	Cotton	Outside	1786
195	Eastern	Groundnu	Outside	331
196	Eastern	Soyabean	Outside	926
197	Eastern	Maize	Outside	2910
198	Eastern	Cotton	Outside	2381
199	Eastern	Groundnu	Outside	794
200	Eastern	Soyabean	Outside	714
201	Eastern	Maize	Under	7143
202	Eastern	Groundnu	Under	1323
203	Eastern	Soyabean	Under	4233
204	Eastern	Cotton	Under	2513
205	Eastern	Maize	Under	8466
206	Eastern	Groundnu	Under	1190
207	Eastern	Soyabean	Under	4894
208	Eastern	Cotton	Under	2381

Obs	Region	Crop	Treat	Yield
209	Eastern	Maize	Outside	2778
210	Eastern	Groundnu	Outside	1455
211	Eastern	Soyabean	Outside	1984
212	Eastern	Cotton	Outside	926
213	Eastern	Maize	Outside	2381
214	Eastern	Groundnu	Outside	1587
215	Eastern	Soyabean	Outside	2910
216	Eastern	Cotton	Outside	926
217	Eastern	Maize	Under	2249
218	Eastern	Groundnu	Under	1058
219	Eastern	Sunflowe	Under	992
220	Eastern	Soyabean	Under	1984
221	Eastern	Maize	Under	4762
222	Eastern	Groundnu	Under	1190
223	Eastern	Cotton	Under	384
224	Eastern	Soyabean	Under	701
225	Eastern	Maize	Under	3307
226	Eastern	Groundnu	Under	119
227	Eastern	Soyabean	Under	423
228	Eastern	Cotton	Under	53
229	Eastern	Maize	Outside	1455
230	Eastern	Groundnu	Outside	1455
231	Eastern	Sunflowe	Outside	661
232	Eastern	Soyabean	Outside	1058
233	Eastern	Maize	Outside	1323
234	Eastern	Groundnu	Outside	820
235	Eastern	Cotton	Outside	542
236	Eastern	Soyabean	Outside	635
237	Eastern	Maize	Outside	423
238	Eastern	Groundnu	Outside	40
239	Eastern	Soyabean	Outside	265
240	Eastern	Cotton	Outside	278
241	Western	Cotton	Under	860
242	Western	Cotton	Under	463
243	Western	Cotton	Under	.
244	Western	Cotton	Under	132
245	Western	Cotton	Under	1587
246	Western	Cotton	Under	1124
247	Western	Cotton	Under	529
248	Western	Cotton	Under	265
249	Western	Cotton	Under	.
250	Western	Cotton	Under	.
251	Western	Cotton	Outside	2050
252	Western	Cotton	Outside	728
253	Western	Cotton	Outside	.
254	Western	Cotton	Outside	265
255	Western	Cotton	Outside	463
256	Western	Cotton	Outside	1058
257	Western	Cotton	Outside	265
258	Western	Cotton	Outside	265
259	Western	Cotton	Outside	.
260	Western	Cotton	Outside	.

Obs	Region	Crop	Treat	Yield
261	Western	Groundnu	Under	265
262	Western	Groundnu	Under	291
263	Western	Groundnu	Under	198
264	Western	Groundnu	Under	132
265	Western	Groundnu	Under	529
266	Western	Groundnu	Under	397
267	Western	Groundnu	Under	265
268	Western	Groundnu	Under	198
269	Western	Groundnu	Under	.
270	Western	Groundnu	Under	.
271	Western	Groundnu	Outside	595
272	Western	Groundnu	Outside	661
273	Western	Groundnu	Outside	265
274	Western	Groundnu	Outside	238
275	Western	Groundnu	Outside	331
276	Western	Groundnu	Outside	331
277	Western	Groundnu	Outside	397
278	Western	Groundnu	Outside	265
279	Western	Groundnu	Outside	.
280	Western	Groundnu	Outside	.
281	Western	Maize	Under	5754
282	Western	Maize	Under	2646
283	Western	Maize	Under	5952
284	Western	Maize	Under	2513
285	Western	Maize	Under	5159
286	Western	Maize	Under	4365
287	Western	Maize	Under	4894
288	Western	Maize	Under	3307
289	Western	Maize	Under	9788
290	Western	Maize	Under	8201
291	Western	Maize	Outside	4299
292	Western	Maize	Outside	1257
293	Western	Maize	Outside	4630
294	Western	Maize	Outside	2778
295	Western	Maize	Outside	767
296	Western	Maize	Outside	728
297	Western	Maize	Outside	5291
298	Western	Maize	Outside	5952
299	Western	Soyabean	Under	1323
300	Western	Soyabean	Under	1257
301	Western	Soyabean	Under	1058
302	Western	Soyabean	Under	132
303	Western	Soyabean	Under	.
304	Western	Soyabean	Under	1190
305	Western	Soyabean	Under	198
306	Western	Soyabean	Under	794
307	Western	Soyabean	Under	.
308	Western	Soyabean	Under	.
309	Western	Soyabean	Outside	1918
310	Western	Soyabean	Outside	1323
311	Western	Soyabean	Outside	.
312	Western	Soyabean	Outside	265
313	Western	Soyabean	Outside	.
314	Western	Soyabean	Outside	198
315	Western	Soyabean	Outside	132
316	Western	Soyabean	Outside	265
317	Western	Soyabean	Outside	.
318	Western	Soyabean	Outside	.

APPENDIX 5.1 AVERAGE CROP YIELDS UNDER AND OUTSIDE CANOPIES OF FAIDHERBIA ALBIDA ACCROSS THE FOUR REGIONS FOR THE 2010/2011 AGRICULTURAL SEASON.

Crop	Treat	N Obs	MEAN YIELD (KG/HA)
Cotton	Outside	39	1184.33
	Under	39	992.36
Groundnu	Outside	40	732.78
	Under	40	582.71
Maize	Outside	38	2927.55
	Under	40	5352.23
Soyabean	Outside	40	993.92
	Under	40	1724.22
Sunflowe	Outside	1	661.00
	Under	1	992.00

APPENDIX 5.2.0 ANALYSIS OF VARIANCE TABLE FOR COTTON YIELD UNDER AND OUTSIDE CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under
Number of observations		78

NOTE: Due to missing values, only 72 observations can be used in this analysis.

The GLM Procedure

Dependent Variable: Yield

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	663360.01	663360.01	1.12	0.2945
Error	70	41616118.31	594515.98		
Corrected Total	71	42279478.32			

R-Square	Coeff Var	Root MSE	Yield Mean
0.015690	70.84583	771.0486	1088.347

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	663360.0139	663360.0139	1.12	0.2945

APPENDIX 5.2.1 T-TEST FOR COMPARING COTTON YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	70
Error Mean Square	594516
Critical Value of t	1.99444
Least Significant Difference	362.46

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	1184.3	36	Outside
A	992.4	36	Under

APPENDIX 5.3.0 ANALYSIS OF VARIANCE TABLE FOR GROUNDNUT YIELD OUTSIDE AND UNDER CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under
Number of observations		80

NOTE: Due to missing values, only 76 observations can be used in this analysis.

The GLM Procedure

Dependent Variable: Yield

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	427950.12	427950.12	1.92	0.1705
Error	74	16534016.13	223432.65		
Corrected Total	75	16961966.25			

R-Square	Coeff Var	Root MSE	Yield Mean
0.025230	71.86418	472.6866	657.7500

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	427950.1184	427950.1184	1.92	0.1705

APPENDIX 5.3.1 T-TEST FOR COMPRISON OF GROUNDNUT YIELDS OUTSIDE AND UNDER CANOPIES OF FAIDHERBIA ALBIDA

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	74
Error Mean Square	223432.7
Critical Value of t	1.99254
Least Significant Difference	216.07

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	732.8	38	Outside
A	582.7	38	Under

APPENDIX 5.4.0 ANALYSIS OF VARIANCE TABLE FOR MAIZE YIELD OUTSIDE AND UNDER CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES FOR THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under
Number of observations		78

Dependent Variable: Yield

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	114565831.6	114565831.6	33.44	<.0001
Error	76	260392326.4	3426214.8		
Corrected Total	77	374958157.9			

R-Square	Coeff Var	Root MSE	Yield Mean
0.305543	44.37821	1851.004	4170.974

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	114565831.6	114565831.6	33.44	<.0001

APPENDIX 5.4.1 T-TEST FOR COMPARING MAIZE YIELDS OUTSIDE AND UNDER CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES IN THE 2010/2011 SEASON

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	76
Error Mean Square	3426215
Critical Value of t	1.99167
Least Significant Difference	835.12
Harmonic Mean of Cell Sizes	38.97436

NOTE: Cell sizes are not equal.

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	5352.2	40	Under
B	2927.6	38	Outside

APPENDIX 5.5.0 ANALYSIS OF VARIANCE FOR SOYA BEAN YIELD OUTSIDE AND UNDER AS A FUNCTION OF CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES IN THE 2010/2011 SEASON

The GLM Procedure

Class Level Information

Class	Levels	Values
Treat	2	Outside Under
Number of observations		80

NOTE: Due to missing values, only 73 observations can be used in this analysis.

Dependent Variable: Yield

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	9731581.64	9731581.64	10.56	0.0018
Error	71	65451073.02	921846.10		
Corrected Total	72	75182654.66			

R-Square	Coeff Var	Root MSE	Yield Mean
0.129439	70.38709	960.1282	1364.068

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Treat	1	9731581.637	9731581.637	10.56	0.0018

APPENDIX 5.5.1 T-TEST FOR COMPARING SOYA BEAN YIELDS OUTSIDE AND UNDER CANOPIES OF MATURE FAIDHERBIA ALBIDA TREES IN THE 2010/2011 SEASON

t Tests (LSD) for Yield

NOTE: This test controls the Type I comparisonwise error rate, not the experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	71
Error Mean Square	921846.1
Critical Value of t	1.99394
Least Significant Difference	448.18
Harmonic Mean of Cell Sizes	36.49315

NOTE: Cell sizes are not equal.

Means with the same letter are not significantly different.

t Grouping	Mean	N	Treat
A	1724.2	37	Under
B	993.9	36	Outside