Impact of soybean (*Glycine max L.*) and maize (*Zea mays L.*) inter-crop on the vegetative and yield performance of yellow oleander (*Thevetia peruviana* (Pers) Schum.)

Aboyeji, C. M *[,a]; Abayomi, Y. A[a]; Aduloju, M. O[b]; and Olofintoye, T. A. J [c]

[a] *Department of Agronomy, University of Ilorin, Ilorin, Nigeria.*
[b] *College of Agricultural Sciences, Landmark University, Omu-aran, Nigeria.*
[c] *National Horticultural Research Institute (NIHORT),Ibadan, Nigeria*
* *Corresponding Author- Aboyeji, C.M* chrismuyiwa@yahoo.com

Vegetative and yield performance of *Thevetia peruviana* (Pers) Schum. were evaluated under soybean (*Glycine max L.*) and maize (*Zea mays L.*) cropping systems during the 2008 and 2009 rainy seasons at the Research Farm of the Biofuel Alternative and Renewable Energy Ltd, Edidi, Kwara State in the Southern Guinea Savanna of Nigeria. The treatment included sole *T. peruviana*, sole soybean, sole maize, *T. peruviana*/soybean and *T. peruviana*/maize cropping systems with *T. peruviana* plant population of 2,500 plants ha^{-1}. The treatments were laid out in Randomised Complete Block Design (RCBD) with four replicates. Two rows of maize at one plant/stand were planted in each plot assigned for *T. peruviana*/maize while four rows of maize were planted in each plot assigned for sole maize. Soybean at two plants/stand was planted in each plot assigned for *T. peruviana*/soybean and sole soybean. Results obtained indicated that *T. peruviana*/soybean cropping system improved the vegetative growth parameters of the two component crops while *T. peruviana*/maize cropping system reduced both the vegetative and the yield parameters of the test crop. However the widest stem width was observed under the control *T. peruviana*. The kernel size of *T. peruviana* was not significantly affected irrespective of the cropping systems. The kernel yield of *T. peruviana* under *T. peruviana*/soybean cropping system increased although statistically similar with sole *T. peruviana* while the seed yield of soybean under *T. peruviana*/soybean cropping system significantly increased when compared with the sole soybean. The complimentary use of growth resources such as nutrients, water and light in *T. peruviana* /soybean cropping system resulted into increase plant height, number of branches and the overall yield of the two component crops. Thus, it can be recommended that for higher yield and sustainability *T. peruviana*/soybean cropping system is better adopted among the cropping systems.

Keywords: *Thevetia peruviana*, Inter-cropping, Vegetative growth and Kernel yield

The ever-increasing prices of exhaustible, non-renewable fossil fuel and the concomitant shortage in supply have set off a revolution in research activities for alternative combustion energy sources to supplement or replace fossil fuels and to reduce the associated pollution problems of their combustion, attention has been drawn towards fuels of biological origin (Marchenko and Semenov 2001, 183-185), which provide a regenerable feedstock. Of these, the most common alternative being developed and used at present are bio-diesels, which are fatty acid methyl esters (FAMEs) of seed oils and fats. A myriad of edible and non-edible oils could be used as bio-diesel feedstocks, but the appropriate technology would be to utilize the abundantly available native non-edible oil feedstocks rather than edible ones. One of these non-edible feedstocks could be *Thevetia peruviana* (Pers) Schum. oil.

Thevetia peruviana (Pers) Schum. is a plant probably native to Mexico, Central America or West Indies (Daniel, 1937). It has naturalized both in the tropics and sub-tropics and grows readily in the wild. It is used as an ornamental plant in churches, schools and homes as flower hedges. It is an evergreen tropical arborescent shrub. The foliage is deep green and glossy that bears yellow or orange-yellow trumpet-like flowers, its fruits are green in colour when unripe and black in colour as it ripens encasing large dicotyledonous seeds. The seed casing is hard

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and the seeds may remain viable after one year of proper storage.

T. peruviana is found in all climatic and vegetational belts in Nigeria and grows to an average height of about 4 meters. In the wild, the plant flowers after one and half years and blooms thrice a year (Balusamy and Manrappan, 2007, 1035-1040). *T. peruviana* produces more than 400-800 fruits yearly depending on the rainfall and plant age (Ibiyemi et al. 2002, 61-65). It reaches maximum fruiting at four years after planting and can live for more than forty years.

Ibiyemi et al. (2002, 61-65) produced quality and significant quantities of bio-diesel from *T. peruviana* seeds and reported that the shrub has a wider range of uses than some tree -born oil seeds such as physic nut (*Jatropha curcas*), castor-oil plant (*Ricinus communis*) and neem (*Azadirachta indica*) which have also been identified as potential sources of quality bio-diesel. The seed of *T. peruviana* contains 50-62% oil (Cake, 1981) and the oil is thermally stable (Ibiyemi et al. 2002, 61-65) and rich in oleic acid, which enables it to produce top rated bio-diesel (Balusamy and Marappan, 2008, 1841-1853) for temperate regions. The detoxified seedcake after extraction of the oil has proven to be suitable as an alternative source of protein in chicken and rats feeds (Oluwaniyi et al. 2007, 188-191).

Compared with the oil content of other tree-born oilseeds (TBO) as karanja (*Pongamia pinnata*), *Jatropha curcas* and *Azadiracta indica* (Srivastava and Verma 2008, 1673-1677;), the oil content of *T. peruviana* seed is very high, hence, it is a potential oil seed crop for bio-diesel production. Ibiyemi et al. (1995, 745-747) rated the bio-diesel from *T. peruviana* as having good quality as a potential source of combustion energy.

Intercropping is a common feature of agriculture in the tropical Africa as well as in the Asian and American tropics (Okigbo 1978 and Kurt 1984, 1-233). Specific intercropping systems have developed over the centuries in the different regions and they are closely adapted to the prevailing ecological and socio-economic conditions. Kurt (1984, 1-233) explained that intercropping system differs frequently from one area to another with changes in soil and local climate while social and cultural conditions may superimpose on the ecological and economical zones.

Ikeorgu (1983, 1-23) and Okigbo (1978) explained that intercropping is the growing of two or more crops simultaneously on the same field such that the period of overlap is long enough to include their vegetative stage. Its profits are risk minimization, increase in farmers' income and food security, reduction of soil erosion, pest and disease control (Bekunda 1999, and Owuor et al. 2002, 1098-1105). Lower weed biomass has been reported in intercropping systems where a main crop was inter-sown with a "smother" crop species (Jodha 1979). Greater crop yield and less weed growth can be obtained more frequently in intercrops than in sole crops.

Lagemann (1977) stressed that the population pressure in south-eastern Nigeria has also led to an intensification of intercropping in order to increase the production per unit area. Intercropping reduces risk of crop failure and ensures the farmer's stable income over time. It helps the farmer to spread his harvest over the season and so ensures a regular supply of food. Therefore, it is a sustainable way of food production and a strategy for resource poor farmers who produce the majority of our foods.

In this study, the need for farmers to practice intercropping to sustain food security and provide income when *T. peruviana* were still young was considered.

Therefore, the objective of this study was to evaluate the impact of intercropping on the growth and yield of *T. peruviana.*

Materials and methods

Experimental Area

The trials were conducted during the 2008 and 2009 rainy seasons at the Research Farm of the Biofuels Alternatives and Renewable Energy Ltd, Edidi, Kwara State Nigeria to assess the impact of intercropping on the vegetative and yield performance of *Thevetia peruviana* (Pers) Schum.

Treatment Combination

The treatment combination included sole *T. peruviana*, sole soybean, sole maize, *T. peruviana*/soybean and *T. peruviana*/maize combinations with *T. peruviana* plant population of 2,500 plants ha^{-1} for each treatment. The treatments were laid out in Randomised Complete Block Design (RCBD) replicated four times.

Planting Technique and Plot Size

The land was ploughed once and harrowed twice to give a well pulverized soil. Thereafter the field layout was carried out to mark out the appropriate number of treatment plots. The size of each plot in the experiment was 80 m^2 and there were five (5) plots in each replicate. The size of each replicate was therefore 400 m^2.

Nursery and Transplanting

T. peruviana seeds were collected from the wild and germinated in a covered and protected nursery in plastic bags for 8 weeks before they were transplanted on a flat field at a spacing of 2 m by 2 m.

Inter-cropping

Two rows of maize (*Zea mays L.*) at one plant/stand were planted at inter-row spacing of 50 cm and intra-row spacing of 25 cm on each plot assigned for *Thevetia*/ Maize while four rows of maize at the same spacing were planted on each plot assigned for sole maize. Soybean (*Glycine max L.*) at two plants/stand were planted at inter-row spacing of 25 cm and intra-row spacing of 25 cm in each plot assigned for sole Thevetia/Soybean and sole soybean. Maize and soybean were interplanted 4 weeks after the field establishment of *T. peruviana*.

Fertilizer Application

NPK-20:10:10 fertilizer was applied only to the maize at the rate of 120:60:60 kg ha^{-1} in two split doses. The first dose was applied when maize plants were at 2 weeks old, while the second dose was applied when maize plants were at 6 weeks old by side placement at about 8-10cm away from the base of the plant.

Weed Control

Manual weeding using hand hoe was employed in all the plots irrespective of the cropping systems at intervals of eight (8) weeks.

Data Collection

a. The measurements made on *T. peruviana* in the two years were as follows: -
   i. Plant height at 8, 16 and 24 weeks after transplanting (WAT)
   ii. Number of primary branches at 8, 16 and 24 weeks after transplanting (WAT)
   iii. Stem width 8, 16 and 24 weeks after transplanting (WAT)
   iv. Kernel diameter (cm)
   v. Kernel length (cm)
   vi. Kernel yield (kg ha^{-1})

b. The measurements made on maize plants (*Zea mays L.*) in the two years were as follows:
   i. Plant Height at 8 weeks after sowing (WAS)
   ii. Number of Leaves at 8 weeks after sowing (WAS)
   iii. Number of Nodes at 8 weeks after sowing (WAS)
   iv. Number of Row/Cob
   v. Weight of Cob (g)
   vi. Grain Yield (kg/ha)

c. The measurements made on soybean plants (*Glycine maxL.*) in the two seasons were as follows:
   i. Plant Height at 8 weeks after sowing (WAS)

ii. Number of Branches/plant 8 weeks after sowing (WAS)
iii. Number of Pods/Plant
iv. Seed Yield (kg/ha)

Data Analysis

The data collected were subjected to analysis of variance (ANOVA) using Statistical Analysis Software (SAS) and the significant treatment means were compared using the Least Significant Difference (LSD) at 0.05 level of probability ($p \leq 0.05$).

Results

Effect of cropping systems on the vegetative growth of *T. peruviana*

The effect of soybean and maize inter-crop on height of *T. peruviana* in 2008 and 2009 is presented in Tables 1 and 2. In 2008 at 8 WAT, the cropping systems did not significantly influence the plant height while at 16 and 24 WAT, *T. peruviana*/soybean cropping system significantly produced taller height for *T. peruviana* which was statistically similar with the control *T. peruviana*. In 2009, *T. peruviana*/soybean produced taller plant height at all weeks after transplanting but was significant only at 8 WAT with Sole *T. peruviana* and *T. peruviana*/Soybean producing a statistically similar plant height.

The effect of soybean and maize inter-crop on the number of branches of *T. peruviana* is presented on Tables 3 and 4 in 2008 and 2009 respectively. In 2008, branch number of *T. peruviana* grown in pure stand or in mixtures was not significantly different at different periods of development. At all sampling periods in 2009, *T. peruviana*/soybean had higher number of branches which was statistically similar with sole *T. peruviana*, while *T. peruviana*/maize cropping system had a statistically lower number of branches at all sampling periods.

Table 1: Effects of cropping systems on plant height (cm) of *Thevetia peruviana* in 2008

Treatment	**Plant Height**		
	8 WAT	**16 WAT**	**24WAT**
Cropping systems			
Sole *T. peruviana* (control)	41.38	72.36ab	90.38ab
T. peruviana/Soybean	42.67	74.73a	93.98a
T. peruviana/Maize	40.43	70.000b	87.40b
LSD (0.05)	2.93	3.80	5.74

Means in a column of any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)
WAT = Weeks after transplanting of Thevetia

Table 2: Effects of cropping systems on plant height (cm) of *Thevetia peruviana* in 2009

Treatment	**Plant Height**		
	8 WAT	**16 WAT**	**24WAT**
Cropping systems			
Sole *T. peruviana* (control)	41.12ab	70.04	90.07
T. peruviana/Soybean	43.52a	73.64	92.07
T. peruviana/Maize	40.13b	71.40	89.49
LSD (0.05)	2.91	3.85	5.72

Means in a column of any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)
WAT = Weeks after Transplanting

Table 3: Effects of cropping systems on number of primary branches of *Thevetia peruviana* in 2008

Treatment	Number of primary branches		
	8 WAT	**16 WAT**	**24 WAT**
Cropping systems			
Sole *T. peruviana* (control)	10.04	25.47	32.82
T. peruviana/Soybean	10.47	25.80	33.04
T. peruviana/Maize	9.24	23.88	31.20
LSD (0.05)	1.29	2.54	3.20

Means in a column of any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)
WAT = Weeks after Transplanting

Table 4: Effects of cropping systems on number of primary branches of *Thevetia peruviana* in 2009

Treatment	Number of primary branches		
	8 WAT	**16 WAT**	**24WAT**
Cropping systems			
Sole *T. peruviana* (control)	9.93a	25.67a	33.80a
T. peruviana/Soybean	10.96a	27.11a	35.60a
T. peruviana/Maize	8.67b	22.76b	29.67b
LSD (0.05)	1.29	2.50	3.00

Means in a column of any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)
WAT = Weeks after Transplanting

Tables 5 and 6 shows the stem width of *T. peruviana* as influenced by soybean and maize inter-crop in 2008 and 2009 respectively. At all sampling periods in 2008, *T. peruviana* in mixture with maize produced smaller stem width which was similar to *T. peruviana/*soybean. In 2009 at 8 WAT, *T. peruviana* had significantly ($p < 0.05$) narrower stems in the *Thevetia*/maize cropping system while the difference in stem width between the control and *T. peruviana*/soybean cropping system was not significant. However, at 16 and 24 WAT, irrespective of the cropping systems, the stem width was not significantly affected although the control still produced a non significant widest width in both years and at all sampling periods.

Table 5: Effects of cropping systems on stem width (cm) of *Thevetia peruviana* in 2008

Treatment	Stem width		
	8 WAT	**16 WAT**	**24WAT**
Cropping systems			
Sole *T. peruviana* (control)	1.00a	1.84a	2.11a
T. peruviana/Soybean	0.97ab	1.78ab	2.10ab
T. peruviana/Maize	0.93b	1.71b	1.97b
LSD (0.05)	0.05	0.12	0.13

Means in a column of any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)
WAT = Weeks after Transplanting

Table 6: Effects of cropping systems on stem width (cm) of *Thevetia peruviana* in 2009

Treatment	Number of primary branches		
	8 WAT	**16 WAT**	**24WAT**
Cropping systems			
Sole *T. peruviana* (control)	1.02a	1.79	2.09
T. peruviana/Soybean	0.97a	1.77	2.08
T. peruviana/Maize	0.90b	1.73	2.00
LSD (0.05)	0.05	0.12	0.13

Means in a column of any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)
WAT = Weeks after Transplanting

Effect of cropping systems on the kernel size of *T. peruviana*

The effect of soybean and maize inter-crop on *T. peruviana* kernel length and diameter (kernel size) in 2008 and 2009 is as shown on Tables 7 and 8 respectively. In both years, irrespective of whether *T. peruviana* was planted sole or inter-cropped with soybean or maize, increase in kernel size was not significant. The control gave a non-significant increase in kernel size.

Table 7: Effects of cropping systems on kernel length (cm) of *Thevetia peruviana* in 2008 and 2009

Treatment	2008	2009	Mean
Cropping systems			
Sole *T. peruviana* (control)	3.35	3.34	3.35
T. peruviana/Soybean	3.26	3.22	3.24
T. peruviana/Maize	3.12	3.17	3.15
LSD (0.05)	0.23	0.24	0.24

Means in a column of any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)

Table 8: Effects of cropping systems on kernel diameter (cm) of *Thevetia peruviana* in 2008 and 2009

Treatment	2008	2009	Mean
Cropping systems			
Sole *T. peruviana* (control)	1.60	1.63	1.62
T. peruviana/Soybean	1.59	1.59	1.59
T. peruviana/Maize	1.58	1.57	1.58
LSD (0.05)	0.07	0.06	0.07

Means in a column of any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)

Effect of cropping systems on kernel yield of *T. peruviana*

Table 9 shows the effect of soybean and maize inter-crop on kernel yield of *T. peruviana* in 2008, 2009 and in the mean of the two years. In 2008 and 2009, *T. peruviana*/soybean produced a higher kernel yield for *T. peruviana* which was also statistically similar with sole *T. peruviana*. However, in the mean of the two years, the difference in kernel yield of *T. peruviana* between the sole *T. peruviana* and *T. peruviana*/soybean cropping system was not significant while *T. peruviana*/maize cropping system still produced a significantly lower kernel yield.

Table 9: Effects of cropping systems on kernel yield (kg ha^{-1}) of *Thevetia peruviana* in 2008 and 2009

Treatment	**2008**	**2009**	**Mean**
Cropping systems			
Sole *T. peruviana* (control)	14.38ab	16.55ab	16.47a
T. peruviana/Soybean	17.20a	18.38a	17.79a
T. peruviana/Maize	9.45b	10.10b	9.78b
LSD (0.05)	6.73	6.63	6.68

Means in a column of any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)

Effect of cropping system on the vegetative growth of maize

The effect of cropping systems on the vegetative growth of Maize in 2008 and 2009 is shown on Table 10. In both years, the effect of cropping systems was not significant on plant height, number of leaves and number of nodes of maize plant. Although, *T. peruviana*/maize cropping system produced non-significant higher values for the parameters than in the sole maize cropping system.

Effect of cropping systems on the yield and yield components of Maize

Table 11 Shows the effect of cropping systems on the yield and yield components of Maize in 2008 and 2009. The number of row/cob, weight of cob and grain yield were not significantly affected by the cropping systems in 2008 while in 2009, the parameters were significantly different between the sole maize and *T. peruviana*/maize cropping systems.

Table 10: Effect of cropping systems on the vegetative growth of Maize at 8 weeks after sowing (WAS) in 2008 and 2009

	Plant height		**Number of leaves**		**Number of nodes**	
Treatments	**2008**	**2009**	**2008**	**2009**	**2008**	**2009**
Cropping system	1.47	1.30	10.25	8.20	11.00	10.23
Sole Maize	1.71	1.45	11.00	8.43	12.32	11.42
Thevetia/Maize	2.09	0.15	2.61	7.12	3.46	1.85
LSD (0.05)						

Means in a column of any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD).

Table 11: Effect of cropping systems on the yield and yield components of Maize in 2008 and 2009

	Number of row/cob		**Weight of cob (g)**		**Grain yield (ka/ha)**	
Treatments	**2008**	**2009**	**2008**	**2009**	**2008**	**2009**
Cropping system						
Sole Maize	13.28	13.04b	351.7	206.2	2,600	2,090b
Thevetia/Maize	14.18	13.84a	373.2	28.1a	3,000	2,790a
LSD (0.05)	2.20	0.68	30.5	75.2	510	185

Means in a column of any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)

Effect of cropping systems on the vegetative growth and yield performance of Soybean

Results in Table 12 Shows that there were no significant differences in plant height and number of branches of soybean in 2008 and 2009 while in both years number of pods/plant and seed yield of soybean significantly increased when intercropped than in sole cropping (Table 13).

Table 12: Effect of cropping systems on the height and number of branches of Soybean at 8 WAS in 2008 and 2009

	Plant height		**Number of branches/plant**	
Treatments	**2008**	**2009**	**2008**	**2009**
<u>Cropping systems</u>				
Sole Soybean	50.10	50.57	4.29	4.42
T. peruviana/Soybean	55.83	55.26	4.80	4.65
LSD (0.05)	6.73	5.69	0.72	0.43

Means in a column of any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)

Table 13: Effect of cropping systems on the number of pods/plant and seed yield (kg/ha) of Soybean in 2008 and 2009

	Number of pods/plants		**Seed yield (kg/ha)**	
Treatments	**2008**	**2009**	**2008**	**2009**
<u>Cropping systems</u>				
Sole Soybean	75.82b	79.80b	1,153b	1,325b
T. peruviana/Soybean	87.33a	85.14a	1,482a	2,473a
LSD (0.05)	10.52	4.20	230	128

Means in a column of any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)

Discussion

Effect of cropping systems on *T. peruviana*

In *T. peruviana* /maize cropping system, maize was observed to be the dominant crop because maize grows faster than *T. peruviana* and its shading effect had negative effect on the growth and yield of *T. peruviana*.

The reduction in the plant height, number of branches and stem width of *T. peruviana* when intercropped with maize could be attributed to competition for environmental resources which occurs when the two component crops compete for the same nutritional and water requirements in the same space which consequently resulted in one plant receiving less nutrients and water than it needed. It could also be as a result of the shading effect of maize which grows faster and taller than *T. peruviana* at the initial stage of development resulting in its reduced photosynthetic activities. Maize requires high nutrients and moisture for its morphological and physiological activities. Similar result was by Ofori and Stern (1987, 177-204) where they observed that most intercropping systems exhibit competition for N between crop components. However, the results indicated that the sole *Thevetia* produced thicker stem width similar to that of *Thevetia*/soybean cropping system. The reason for this could be traced to less competition for growth resources experienced by the sole *T. peruviana*.

The result also indicated that control *T. peruviana* gave a non-significant increase in both the kernel length and kernel diameter (kernel size). This showed that the kernel size was not affected irrespective of the cropping systems.

Intercropping has been reported to have yield increase over sole cropping. These yield increase can occur as a result of complementary use of growth resources such as nutrients, water and light by the component crops (Enyi 1973, 83-90). The yield increase may be in terms of higher yield or higher net income. He further explained that the yield can be quantified in terms of dry matter production, grain or root yields, nutrient uptake, energy or protein production and market value.

Complementarities occur when the growth pattern of the component crops differs so that the crops can make their demand for resource at different times. The result of this experiment also revealed that *T. peruviana*/soybean cropping system produced higher values for plant height, number of branches, stem width and kernel yield which was similar to the control *T. peruviana*. This could be attributed to difference in their resource use. It could also be as a result of efficient use of water by the components crops where soybean serves as cover crop for thevetia. According to Okigbo (1978) and Kurt (1984, 1-233), intercrops have better water use efficiency than sole crops. They explained that this is of special importance for farmers in the semi-arid tropics where water is the main limiting factor of production. They reported that one of the reasons for increased water use efficiency of intercrops is the windbreak effect. Okigbo (1978) observed that when low growing crops are interplanted with tall growing ones, this leads to reduced evapotranspiration.

The number of branches determines the size of the canopy which is related to total kernel yield. It affects the size of the source of photosynthates and therefore, the size of the sink. Increased yield in *T. peruviana* kernel was recorded in the *T. peruviana* /soybean cropping system and was statistically similar with the control *T. peruviana*. This could be attributed to the increased number of branches produced under *Thevetia*/soybean cropping system and the sole *T. peruviana*.

Effect of cropping systems on Maize and Soybean

It was also observed from the result that the effect of the test crop (*Thevetia peruviana*) was not significant on the vegetative growth of the intercropped (soybean and maize) plants. The reason could be that the two intercropped plants are annuals and grow faster than the test crop which is a perennial.

Yield and yield components of maize increased when intercropped with *T. peruviana* than in sole maize in both years but only significant in 2009. The yield increase could be as a result of high compatibility of maize in cropping systems due to its mode of photosynthesis. Ikeorgu (1983, 1-23) reported that maize compatibility in mixtures was attributed to the fact that it is a C4 plant, and giving reasons why C4 plants are successful in most cropping systems.

The significant increase in the number of pods/plant and the seed yield between the sole soybean and *T. peruviana*/soybean cropping system could be attributed to the variety of rooting systems in the soil which reduces water loss, nutrient loss, increases water uptake and transpiration.

Conclusion

Crop performance in cropping systems is often determined by the efficiency of the component crops to capture and utilize the available production resources (light, water, nutrient) which can be influenced by plant architecture and population density of the component crops in the mixture. *T. peruviana* and soybean provide an example of the presence of competition gap within the period each of the component crops make maximum demands on the environmental growth resources which results in higher total yields than the sole crops. This research therefore concludes that the shading and dominance effect of maize caused reduction in both the vegetative and yield of *T. peruviana* while the complimentary use of growth resources such as nutrients, water and light in *T. peruviana/*soybean cropping system resulted in increased plant height, number of branches and the overall yield of the two component crops. Thus, it can be recommended that for higher yield and sustainability *T. peruviana* /soybean cropping system is better adopted among the cropping systems.

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