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The Effect of Plant Population Density on Yield and Yield Parameters of Potato, Maize and Beans in an Intercropping System in Bambili, the Western Highlands of Cameroon

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Abstract: Plant population density in intercropping system is known to directly affect competition among component crop as well as their yields. In a bit to establish appropriate population density in an intercropping system in Bambili, a field experiment was conducted with treatments Sole Potato (33,333 plants/ha), Sole maize (40,000 plants/ha), sole beans (66,666 plants/ha), potato 30 cm/maize 25 cm (73,333 plants/ha), potato 30 cm/maize 50 cm (53333 plants/ha), potato 30 cm/beans 15 cm (99,999 plants/ha), potato 30 cm/beans 30 cm (66,666 plants/ha) and potato 30 cm/Maize 100 cm/Beans 60 cm (59,333 plants/ha) using a Randomized Complete Block Design with four (4) replicates. Data was collected on growth and yield parameters and the analysis of variance (ANOVA) was done using the Statistical Package for Social Sciences (SPSS) version 26. Means were separated using Fischer's least significance difference (LSD). Results obtained showed that intercropping potato, maize and beans had no effect on percentage emergence and percentage plant vigor but significant differences ($P \leq 0.05$) on plant height and groundcover. Significant differences ($P \leq 0.05$) between numbers of tubers per potato plants were obtained in both intercropping and sole cropping while the differences in the number of pods per beans plant and number of cobs per maize plant were not significant ($P \geq 0.05$). Intercropping had a negative effect on the average weight of tubers per potato plant which resulted to lower tuber weights per plant in intercropping as compared to sole cropping. In the case of beans and maize, intercropping had no significant effect ($P \geq 0.05$) on the average weight of pods, but there was significant ($P \leq 0.05$) difference in the average weight of maize grains. Overall the yields of potato per hectare, maize per hectare and beans per hectare were significantly ($P \leq 0.05$) affected by intercropping. Comparing the intercropping treatments, potato/maize at 25 cm had the best maize grain yield (1.7 tons/ha) while potato/beans at 15 cm had the best beans yield (2.4 tons/ha). More research on Potato /beans (99,999 plants/ha), Potato /maize (53333 plants/ha) and Potato /maize (73,333 plants/ha) as appropriate intercropping systems is recommended.

Keywords: Potato, Maize, Beans, Intercropping, Plant Spacing, Population Density

1. Introduction

Intercropping is a system of crop production whereby two or more crops are planted together in definite patterns and densities based on geographical location and variety. Plant density which is simply defined as the number of individual plants per unit ground area is an important agronomic factor that manipulates micro environment of the field and affects growth, development and yield of crops [1, 6]. Optimum density of component crops in intercropping systems depends on geographical location as well as crop varieties involve [2-5]. Plant density is therefore an important factor determining the economic viability of an intercropping system. Plant population density can determine the success or failure of intercropping as well as the degree of

competition among component crops.

Two types of competitions are recognized among component crops in intercropping systems. Competition among plants of the same species is referred to as intraspecific competition and that among plants of two or more species is interspecific competition [7, 8]. Competition in an intercropping has been shown to have significant impact on growth rate and yield of plant species that are components of the intercropping, [9]. While a meta-analysis of multiple cropping studies shows that intraspecific competition tends to be much stronger than interspecific competition, high yields in intercropping have been reportedly achieved when interspecific competition is lower than intra-specific [10].

Intercropping system is appreciated worldwide because of its potentials, to offer sustainable benefits such as prevention of soil erosion, protection of main crop, additional nutrients for the main crop which in turn reduce fertilizer [9]. Hence Intercropping is sustainable crop production practice with potentials to boost farmers income and hence livelihood in line with the poverty reduction strategies of the United Nations Organizations. Now-a-days self-sustaining, diversified, low-input, and energy-efficient agricultural systems like intercropping are promoted as the efficient way to achieve the sustainability in agriculture by many farmers, researchers, and policy makers' worldwide [11]. Intercropping is a common practice in many areas of Africa as a part of traditional farming systems commonly implemented in the regions with declining land sizes and food security needs [12].

Small holder farmers in Bambili and the entire Western highlands of Cameroon depend heavily on maize, potato and beans for food and income security. They essentially intercrop these crops with the hope to reap especially the high yields research has stipulated as possible in intercropping systems. Despite having done this throughout their years of practicing agriculture, no specific planting pattern or planting density has been established as standard for farmers in Bambili. Bases on knowledge that plant density affects yields of crops in intercropping systems and that optimum density of component crops depends on geographical location as well as crop variety, the need to optimize plant density of component crops in intercropping systems across various geographical locations for appropriate yield achievement becomes evident. This study was carried out to assess the performance of potato in multiple cropping with varying plant spacing of the component crops both on growth and yield characteristics of the crop in Bambili, western highlands of Cameroon.

2. Materials and Method

2.1. Site Description

This study was carried out at the research farm of the Regional College of Agriculture Bambili, located in the Northwest Region of Cameroon. It has geographical coordinates 5°59′0″ North, 10°15′0″ East, with an altitude of 1,558m above sea level. This area has temperature ranges from 13-18°C, characterized by annual rainfalls of 2230 mm and average humidity of 70% and 52% in the rainy season and dry season respectively [18].

2.2. Experimental Materials

The experimental was layed in a randomized complete block design with four (4) replicates. Each block (replicate) had eight experimental units and each experimental unit measured 3m x 1m. Each replicate was separated by a path of 0.5m, with an intra-replicate spacing of 0.5m giving a total land area of 195.75 m^2. Potato which was the base crop maintained its plant to plant distance of 30cm while that of the accompanying crops varied. The distances between ridges were 1m for all crops.

Table 1. *Descriptions of experimental treatments.*

Treatment	Description of planting distances
Sole Potato (33,333plants/ha)	30cm between plants
Sole maize (40,000 plants/ha)	25cm between plants
Sole beans (66,666 plants/ha)	15cm between plants
Potato /maize (73,333 plants/ha)	30 cm/ 25 cm between plants respectively
Potato /maize (53333 plants/ha)	30 cm/ 50 cm between plants respectively
Potato /beans (99,999 plants/ha)	30 cm/ 15cm between plants respectively
Potato /beans (66,666 plants/ha)	30 cm/ 30 cm between plants respectively
Potato /Maize /Beans (59,333 plants/ha)	30 cm, 100 cm / 60 cm between plants respectively

2.3. Agronomic Practices

A surface area of 200 m^2 was cleared with a machete and ploughed with a hoe. Planting was done on the 20th of June and harvested on the 15th of September 2020. One seed potato tuber was planted per hole at a depth of 10cm and at plant to plant distances of 30cm. NPK 14:24:14 fertilizer was applied on potato at planting following the rate of 120N, 180P, and 100K giving 72g of NPK 14:24:14 per plant recommended by Njualem 2010. Urea was applied at 5g per plant on all crops at 4 WAP. Maize and beans were planted at two seed per hole and later thinned to 1 seed per hole at 4WAP. The first weeding and molding were done at 4 WAP and second at 8WAP. The field was sprayed with cypercot a systemic insecticide and Pencozeb 80WP a contact fungicide against insects and

fungi pests respectively. The spraying interval was twice a week during moments of high rain intensity and once a week for moderate intensity.

2.4. Data Collection and Analysis

During vegetative growth, data were collected on plant height, plant vigor and ground cover. At harvest, average productivity of potato tuber per unit area (ton/ha), maize and beans grain yield (ton/ha) were recorded alongside average number of tuber per potato plant, / average number of cobs per corn plant and average number of pods per bean plant were collected. Also measured were Weight of potato tubers per plant, weight of bean pods per plant and weight of 100 grains per maize plant.

Data collected on vegetative and Yield parameters were subjected to analysis of variance (ANOVA) using the Statistical Package for Social Sciences (SPSS) version 26. Treatment means were separated using the Least Significant Difference (LSD) and results were presented using tables.

3. Results and Interpretation

3.1. Effect of Plant Population Density on Plant Height, Percentage Groundcover and Percentage Plant Vigor

3.1.1. Effect of Plant Population Density on Plant Height

Results on effects of population densities from different treatments on plant heights are presented in table 2 below. Measurements were taken at seventy five days after planting (75DAP). Values (means) with the same letters are not significantly different at P> 0.05 while values with different letters are significantly different at P ≤ 0.05 according to LSD test. Value ±standard error.

Table 2 shows intercropping and/or population density of the stand to have significantly (P≤0.05) affected the height of plants. The significant (P≤ 0.05) difference in potato heights under sole potato (33,333 plants/ha) and under intercrop of Potato with Maize at 30cm and 25cm (73,333 plants/ha) and at 30cm and 50 cm (53333 plants/ha) planting distances respectively are obvious from table 2.

Table 2. *Effects of plant population density on plant height.*

Treatment	Height		
	Potato	Beans	Maize
Sole Potato (33,333 plants/ha)	78.7175±4.37^{a}		
Sole maize (40,000 plants/ha)			125.6500±6.72^{a}
Sole beans (66,666 plants/ha)		23.49±1.78a	
Potato /maize (73,333 plants/ha)	59.0175±.81^{c}		122.9325±4.06^{a}
Potato /maize (53333 plants/ha)	60.9750±1.03^{bc}		132.7125±4.17^{a}
Potato/beans (99,999 plants/ha)	64.6250±1.48^{bc}	20.06±0.82^{a}	
Potato /beans (66,666 plants/ha)	67.5750±1.12^{b}	20.5±0.87^{a}	
Potato /Maize /Beans (59,333 plants/ha)	76.1500±4.49^{ab}	21.19±0.47^{a}	116.3100±6.33^{a}

The tallest (78.71cm) potato plants were recorded with sole potato (33,333 plants/ha) while the shortest (59.01cm) were recorded with Potato/Maize intercrop planted at 30cm/25cm respectively and with a population density of 73,333 plants/ha. The same trend can be observed with beans plant heights. The treatment sole beans (66,666 plants/ha) had the tallest average plant height (23.49cm) while Potato/beans at 15cm (99,999 plants/ha) recorded the shortest (20.5cm) average plant height. Maize plant heights differed significantly (P≤0.05) between the three treatments; Potato /maize (73,333 plants/ha) at 30 cm/ 25 cm between plants respectively, Potato /maize (53333 plants/ha) at 30 cm/ 50 cm between plants respectively and Potato /Maize /Beans (59,333 plants/ha) at 30 cm, 100 cm / 60 cm between plants respectively. The tallest maize plants (132.7cm) were observed with treatment Potato /maize (53333 plants/ha) planted at 30 cm/ 50 cm between plants respectively while the shortest (116.3cm) were obtained from the treatment Potato /Maize /Beans (59,333 plants/ha) plants at 30 cm, 100 cm / 60 cm between plants respectively.

3.1.2. Effect of Plant Population Density on Percentage Ground Cover and Percentage Plant Vigor

Results of effects of population densities from different treatments on Percentage ground cover and percentage plant Vigor are presented in table 3 below. Values (means) with the same letters are not significantly different at P> 0.05 while values with different letters are significantly different at P ≤ 0.05 according to LSD test. Value ±standard error.

Table 3. *Percentage (%) groundcover and percentage (%) plant vigor as influenced by intercropping system of potato, maize and beans.*

Treatment	Percentage (%) Groundcover	Percentage (%) Vigor		
		Potato	Beans	Maize
Sole Potato (33,333 plants/ha)	51.5000±1.47^{bc}	94.7222±3.06^{a}		
Sole maize (40,000 plants/ha)	16.13±1.36^{d}			65.63±15.37^{a}
Sole beans (66,666 plants/ha)	20±0.58^{d}		68±10.83^{a}	
Potato /maize (73,333 plants/ha)	64.75±2.93^{a}	100.0±00^{a}		82.50±8.07^{a}
Potato /maize (53333 plants/ha)	55.50±3.20^{b}	94.097±3.42^{a}		77.50±13.15^{a}
Potato/beans (99,999 plants/ha)	53.8750±3.84^{b}	96.8750±3.13a	72.8±9.65^{a}	
Potato /beans (66,666 plants/ha)	44.8750±11.04^{c}	91.3194±5.39^{a}	88.02±0.92^{a}	
Potato/Maize /Beans (59,333 plants/ha)	49.5000±6.21^{bc}	72.2222±24.21^{a}	85±9.57^{a}	39.58±21.35^{a}

(i). Percentage (%) Plant Vigor

Table 3 above show the highest (100%) percentage potato plant vigor to have obtained with the treatment Potato/maize (73,333 plants/ha) planted at 30 cm/ 25 cm between plants respectively while the lowest (72.22%) were recorded with the treatment potato/Beans (59,333 plants/ha) planted at 30 cm, 100 cm / 60 cm between plants respectively. Based on the analysis of variance inferable from table 3, no significant differences (P> 0.05) existed in the percentage potato plant vigor between the treatments. Similarly no significant differences were obtained with percentage plant vigor for beans between the treatments. The treatment Potato/beans (66,666 plants/ha) planted at 30 cm/ 30 cm between plants respectively showed the highest (88.02%) average percentage plant vigor while sole beans (66,666 plants/ha) planted at 15cm between plants showed the lowest (68.00%) average percentage plant vigor. The highest (82.5%) average percentage plant vigor for maize was recorded with treatment Potato/maize (73,333 plants/ha) planted at 30cm/ 25cm between plants respectively while treatment Potato/Maize /Beans (59,333 plants/ha) planted at 30 cm, 100 cm / 60 cm between plants respectively recorded the lowest (39.58%). Statistical analysis of variance carried out revealed no significant (P> 0.05) differences between the treatments.

(ii). Percentage Groundcover

Ground cover measurements were done 45 days after planting (45DAP). Significantly ($P \leq 0.05$) differing values were obtained between the treatments. Groundcover recorded with the different treatments ranged from lowest (16.13%) recorded with treatment sole maize (40,000 plants/ha) planted at 30 cm to highest (64.75%) recorded with treatment Potato/maize (73,333 plants/ha) planted at 30 cm/ 25 cm between plants respectively.

3.2. Effect of Plant Population Density on Yield Parameters of Component Plants

Yield parameters collected for the different component plants included, number of tubers per potato plant, number of pods per bean plant and number of cobs per maize plant. Weight of potato tubers per plant, weight of bean pods per plant and weight of 100 grains per maize plant were also measured. Finally Yields per hectare of potato, maize and beans were calculated. The results are displayed in tables 4, 5 and 6 below. Values (means) with the same letters are not significantly different at P<0.05 while values with different letters are significantly different at P<0.05 according to LSD test. Value ±standard error.

3.2.1. Effect of Plant Population Density on Number of Tubers Per Potato Plant, Number of Pods Per Bean Plant and Number of Cobs Per Maize Plant

The table below present results obtained for effects of plant population density on number of tubers per potato plant, number of pods per bean plant and number of cobs per maize plant. Values (means) with the same letters are not significantly different at P> 0.05 while values with different letters are significantly different at $P \leq 0.05$ according to LSD test. Value ±standard error.

Table 4. *Average Number of tubers/potato plant, Number of pods/bean plant and Number of cobs per maize plant as influenced by intercropping system of potato, maize and beans.*

Treatment	No of tubers / Potato plant	No of pods / Beans plant	No of cobs / Maize plant
Sole Potato (33,333 plants/ha)	7.1750±0.32[a]		
Sole maize (40,000 plants/ha)			1.0750±0.08[a]
Sole beans (66,666 plants/ha)		8.9275±0.497[b]	
Potato /maize (73,333 plants/ha)	7.08±1.41[a]		1.0750±0.08[a]
Potato /maize (53333 plants/ha)	7.11±1.11[a]		1.2000±0.12[a]
Potato/beans (99,999 plants/ha)	6.2125±0.57[b]	6.0250±0.21[a]	
Potato /beans (66,666 plants/ha)	6.7875±0.81[ab]	7.0500±0.31[a]	
Potato/Maize /Beans (59,333 plants/ha)	4.4000±0.37[c]	6.0625±0.45[a]	1.0000±0.0[a]

The table shows the different treatments to have produced different numbers of tubers/ potato plants with the lowest (4.40) coming from the treatment Potato/Maize /Beans (59,333 plants/ha) planted at 30 cm, 100 cm / 60 cm between plants respectively and the highest (7.18) from the treatment sole potato (33,333 plants/ha) planted at 30cm between plants. Based on the ANOVA results, the number of tubers per potato plant differed significant ($P \leq 0.05$) among treatments. With ANOVA showing no significant (P> 0.05) differences among treatments, the average number of pods per bean plant ranged from 6.0 pods with treatment Potato/beans (99,999 plants/ha) planted at 30 cm/15cm between plants respectively to 8.9 pods in Sole beans (66,666 plants/ha) planted at 15cm between plants. ANOVA also revealed no significant (P> 0.05) differences in the number of cobs per maize plant between the treatments. Number of cobs per maize plant ranged from 1.0cob per plant measured with treatment Potato /Maize /Beans (59,333 plants/ha) planted at 30 cm/ 50 cm between plants respectively to 1.2 cobs per plant measured with treatment potato/maize (53333 plants/ha) planted at 30 cm/ 50 cm between plants respectively.

3.2.2. Effect of Plant Population Density on Weight of Potato Tubers Per Plant, Weight of Bean Pods Per Plant and Weight of 100 Grains Per Maize Plant

Results of plant population density effects on Weight of potato tubers per plant, weight of bean pods per plant and weight of 100 grains per maize plant are presented in table 5

below. Values (means) with the same letters are not significantly different at P> 0.05 while values with different letters are significantly different at P ≤ 0.05 according to LSD test. Value ±standard error.

Table 5. *Weight of potato tubers per plant, weight of bean pods per plant and weight of 100 grains per maize plant as influenced by intercropping system of potato, maize and beans.*

Treatment	Average tuber weight/potato Plant	Average pod weight/bean Plant	Average 100 grains weight /Maize Plant
Sole Potato (33,333 plants/ha)	522.3200±54.46^{a}		
Sole maize (40,000 plants/ha)			47.8250±0.62^{c}
Sole beans (66,666 plants/ha)		35.9625±0.87^{a}	
Potato /maize (73,333 plants/ha)	351.040±126.06^{a}		42.7750±0.97^{a}
Potato /maize (53333 plants/ha)	450.2000±93.21^{a}		43.2500±1.08^{a}
Potato/beans (99,999 plants/ha)	367.9425±88.49^{a}	27.9250±3.02^{a}	
Potato /beans (66,666 plants/ha)	363.1750±18.53^{a}	32.1125±1.57^{a}	
Potato/Maize /Beans (59,333 plants/ha)	307.1225±27.54^{a}	27.1375±3.05^{a}	38.5000±1.24^{b}

Analysis of variance revealed significant differences among the treatment. The table show treatment Sole Potato (33,333 plants/ha) planted at 30cm between plants to have produced the heaviest (522.3g/plant) potatoes while the lightest (307.1g/plant) were produced by treatment Potato/Maize /Beans (59,333 plants/ha) planted at 30 cm, 100 cm / 60 cm between plants respectively. According to ANOVA results, significant (P ≤ 0.05) differences in Weight of potato tubers per plant were observed between the treatments.

Table 5 shows that no significant differences in average weight of pods per bean plant were observed between the treatments. Potato/Maize /Beans (59,333 plants/ha) planted at 30 cm, 100 cm / 60 cm between plants respectively produced the lowest (27.1375g) average weight of pods per bean plant while treatment Sole beans (66,666 plants/ha) planted at 15cm between plants produced the highest (35.96g). The average weight of 100 grains/plant for maize ranged from 38.5g in Potato/Maize /Beans (59,333 plants/ha) planted at 30 cm, 100 cm / 60 cm between plants respectively to 47.83g in Sole maize (40,000 plants/ha) planted at 25cm between plants with significant differences observed between the treatments.

3.3. Effect of Plant Population Density on Per Hectare Yield of Potato, Maize, Beans

Treatments effects on per hectare yields of potato, maize, beans as components crops in this intercropping experiment are presented in table 6 below. Values (means) with the same letters are not significantly different at P> 0.05 while values with different letters are significantly different at P ≤ 0.05 according to LSD test. Value ±standard error.

Table 6. *Per hectare Yield of potato, maize, beans as influenced by intercropping system of potato, maize and beans.*

Treatment	Potato Yield (t/ha)	Maize Yield (t/ha)	Beans Yield (t/ha)
Sole Potato (33,333 plants/ha)	16.4105±1.82^{a}		
Sole maize (40,000 plants/ha)		1.9130±0.02^{a}	
Sole beans (66,666 plants/ha)			2.4010±0.06^{a}
Potato /maize (73,333 plants/ha)	11.7025±4.17^{bc}	1.7110±0.04^{b}	
Potato /maize (53333 plants/ha)	15.0075±3.11^{a}	0.8653±0.02^{c}	
Potato/beans (99,999 plants/ha)	12.2660±2.95^{b}		1.8668±0.199^{b}
Potato /beans (66,666 plants/ha)	12.8550±1.30^{b}		1.0705±0.05^{c}
Potato/Maize /Beans (59,333 plants/ha)	10.2400±0.92^{c}	0.3850±0.01^{d}	.4105±0.04^{d}

The table shows yield/ha of component crops to have significantly differed between the treatments. The highest (17.41t/ha) Potato yield/ha was obtained with treatment sole potato (33,333 plants/ha) planted at 30cm between plants and the lowest (10.24t/ha) was recorded with treatment Potato/Maize /Beans (59,333 plants/ha) planted at 30 cm, 100 cm / 60 cm between plants respectively. Analysis of variance revealed no significant (P> 0.05) differences between the treatments. Beans yield/ha ranged from 0.41tons/ha with treatment Potato /Maize /Beans (59,333 plants/ha) planted at 30 cm, 100 cm / 60 cm between plants respectively, to 2.40tons/ha in Sole beans (66,666 plants/ha) planted at 15cm between plants with significant (P ≤ 0.05) differences observed between the treatments. Similarly, maize grain yield/ha ranged from 0.38t/ha Potato/Maize /Beans (59,333 plants/ha) planted at 30cm, 100 cm / 60 cm between plants respectively, to 1.97t/ha in Sole maize (40,000 plants/ha) planted at 25cm between plants.

4. Discussion and Conclusion

Sole crop is what modern agriculture promotes as monoculture by virtue of its potentials to yield higher (ceteris paribus). Hence the best approach to selecting appropriate intercropping component plants as well as their planting densities should be by comparing results of diverse intercropping combinations with those of sole crops for the base crop intended. This research can therefore help in the selection of appropriate component crops, planting distances as well as planting densities for use to achieve best yields of potato, beans and maize in an intercropping system in Bambili.

In a case where the interest is to select appropriate intercropping system for best yields of potato as base crop, the following discussions and conclusions are possible from the results and interpretations in the preceding chapter. Sole Potato (33,333 plants/ha) at 30cm between plants recorded the best results for both the growth and yield parameters selected. Sole Potato (33,333 plants/ha) at 30cm between plants, produced the tallest (78.2cm) plants seconded by 76.2cm recorded with treatment Potato /Maize /Beans (59,333 plants/ha) planted at 30 cm, 100 cm / 60 cm between plants respectively. Treatment Potato /beans (66,666 plants/ha) planted at 30 cm/ 30 cm between plants respectively produced the third tallest (67.6) plants. Treatment Potato/beans (99,999 plants/ha) planted at 30 cm/ 15cm between plants respectively produced the fourth tallest (64.6cm) potato plants. The fifth (61cm) and sixth (59cm) tallest plants were recorded with treatments; Potato /maize (53333 plants/ha) and Potato /maize (73,333 plants/ha) respectively. Now when yield parameters especially number of Potato tubers per plant, average tuber weight and final yield per hectare are considered, a different trend is observed. While the Sole Potato (33,333 plants/ha) remain highest in all these yield parameters, the treatment Potato /maize (53333 plants/ha) planted at 30 cm/ 50 cm between plants respectively, produced the second best results for all the three yield parameters. The treatment Potato /Maize /Beans (59,333 plants/ha) planted at 30 cm, 100 cm / 60 cm between plants respectively now produces the lowest of the three yield parameters. This was certainly due to increased competitions which most have etiolated plants in the case of vegetative parameters. Considering that the tallest plants with Sole Potato (33,333 plants/ha) produced highest yield parameters gives more reason to believe that etiolation was as a result of competition in search of sunlight for photosynthesis which is basic to yield formation. Similar results have been gotten with the research of [14-16] in their studies of effects of increased density of component plant on plant height and yield parameters.

The possible conclusion that can be drawn from this discussion is that more research on the treatment Potato /maize (53333 plants/ha) planted at 30 cm/ 50 cm between plants respectively as appropriate intercropping system for a good yield of potato in Bambili.

A similar argument considering beans as a base crop can be put up using the results of these experiments. From the preceding results and interpretation, Sole beans (66,666 plants/ha) like sole maize produced the tallest (23.5cm) plants, the largest number (88.9 pods/plant) of pods per plant, and the heaviest (36g) bean pods per plant and the highest yields (2.4t/ha) in tons per hectare. In order to select appropriate intercropping system for a good yield of bean as base in an intercropping in Bambili, results of the various intercropping combinations are compared and the one that perform closer to the sole crop is selected for further consideration. If we compare different treatments, we can infer that the second tallest (21.2cm) beans plants were produced with the treatment Potato /Maize /Beans (59,333 plants/ha) planted at 30 cm, 100 cm / 60 cm between plants respectively. The second heaviest (32.1g) pods per plant were produced by treatment Potato /beans (66,666 plants/ha) planted at 30 cm/ 30 cm between plants respectively. The second highest (1.87t/ha) bean yield per hectare came from the treatment Potato /beans (99,999 plants/ha) planted at 30 cm/ 15cm between plants respectively. This beans actually produced the shortest (20.1cm) bean plants compared to Sole beans (66,666 plants/ha) which produced the tallest (23.5cm) but ended up with the highest per hectare yields of 2.4 t/ha. Based on this and the fact that the second tallest bean plants came from the treatment Potato /Maize /Beans (59,333 plants/ha), one expectations would have been that the second highest yield should also come from this treatment. Negative competition as well as reduced number of beans plants per surface area due to higher planting distances (60cm) compared to 15cm with Sole beans (66,666 plants/ha) and 15cm with Potato /beans (99,999 plants/ha) is a possible reason behind this reduction in yield. Hence higher plant populations resulting from lower plant spacing must have individually or jointly accounted for the observed discrepancy as already reported by [17].

Concluding from these arguments on beans as base crop, farmers in Bambili can cautiously be advised to have a further look into intercropping Potato /beans (99,999 plants/ha) planted at 30 cm/ 30 cm between plants respectively as appropriate for a good yield of beans in Bambili.

The same arguments can be followed when the interest is in maize as the base crop. The results as presented above shows that unlike potato and beans the tallest maize plants were obtained not with Sole maize (40,000 plants/ha) planted 25cm between plants, but with the treatment Potato /maize (53333 plants/ha) planted at 30 cm/ 50 cm between plants respectively. Based on the observation that the highest percentage groundcover was recorded by this same treatment, it can be argued that plants benefited from better soil moisture conserved by the potato canopy as compared to Sole maize (40,000 plants/ha). [17, 16] had both made the same observations in their research on groundcover effects in an intercropping. Unlike the case with potato and beans where highest yields were obtained with sole crops, the highest number of maize cobs per plant were obtained with treatment Potato /maize (53333 plants/ha) while the highest yield per hectare and highest 100 grains weight /Maize Plant were recorded with Sole maize (40,000 plants/ha).

Further research is recommended on the treatments Potato /beans (99,999 plants/ha) planted at 30 cm/ 30 cm between plants respectively, Potato /maize (53333 plants/ha) planted at 30 cm/ 50 cm between plants respectively and Potato /maize (73,333 plants/ha) as promising intercropping systems for good yields of beans, potato and maize in Bambili.

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