Effects of intercropping patterns of bambara groundnut (*Vigna subterranea* (l.) verdc) and chilli pepper (*capsicum frutescens* (l.)) on growth, yield and insect pest management in Southwestern Nigeria

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Abstract
Bambara groundnut, an important legume in Sub-Saharan Africa, suffers significant yield losses due to insect pest infestations in traditional farming systems, prompting the need for sustainable pest management strategies like intercropping. This study evaluated the effects of different intercropping patterns with chilli pepper on bambara groundnut growth, insect pest populations, pod damage, grain yield, and yield loss. Field studies were conducted in a randomized complete block design (RCBD) with three replications during the 2022 wet season at Yaba College of Technology Teaching and Research Farm. The 12 plots with 60 ridges trial were arranged as alternate, strip, border and sole cropping of bambara groundnut. Results showed that alternate intercropping significantly ($P \leq 0.05$) increased the number of leaves (up to 39.00 ± 5.63 at 6 WAP in strip cropping, but overall better growth in alternate intercropping 40.63 ± 5.63) and plant height (10.93 ± 1.05), reduced thrips (3.33 ± 1.09), legume pod borers (1.76 ± 0.35), pod sucking bugs (1.76 ± 0.35), and overall pest populations (1.33 ± 0.49) compared to sole cropping which had highest infestations (thrips 8.33 ± 1.09, pod borers 3.74 ± 0.35, pest population 3.67 ± 0.49). Pod damage was lowest in alternate intercropping (5.67 ± 1.23%), with improved grain yield and reduced yield loss (299.58 ± 9.41 kg/ha) relative to sole cropping (pod damage 15.33 ± 1.23%, yield loss 442.32 ± 9.41 kg/ha). Alternate intercropping is recommended as an effective, environmentally friendly strategy for resource-poor farmers to enhance bambara groundnut production and manage insect pests sustainably.

Keywords: Intercropping, bambara groundnut, chilli pepper, insect pests, cropping pattern.

Introduction

Bambara groundnut (*Vigna subterranea* (L.) Verdc) belongs to plant family *Leguminosae* grown extensively throughout Sub-Sahara Africa (Bamishaye *et al.,* 2011). It is indigenous to the dry savannah of the Northern Nigeria and Cameroon from where it was widely cultivated in tropical regions since 17th Century (Raemaekers, 2001). It is used both as food and fodder crop. The seeds are rich in protein (19%), fat and oil (6.5%) and carbohydrates (63%), making it more balanced than groundnuts and soybean, which are lower in carbohydrates (Okuku, 1999). Medicinally, water from boiled leaves is used for diarrhea in humans, pounded leaves is used against ticks in cattle while cauterized dried leaves are used to heal wounds in animals (Gambo *et al.,* 2009).

Like other legumes, bambara groundnuts are attacked both on the field and in storage by insect pests, causing significant damage. However, traditional agriculture associated with the developing countries is characterized by intercropping. Inclusion of legume in intercropping has been found to affect growth, development and yield through nitrogen fixation in the soil (Keating and Carberry, 1993) and offer remedial control against insect pests attack wherein the crop must consider pest profile (Adipala *et al.,* 2000) as well as effective resource management and increased productivity (Rosulu *et al.,* 2022). The crop is presently grown throughout the country (with the exception of the riverine and swampy areas) and often intercropped with cereals (millet, sorghum and maize), tuber crops (yam, cassava, sweet potato, etc.), traditional vegetables, fibres (cotton) and other legumes (such as cowpea) (IPGRI, 1995; Raemaekers, 2001) with an average yield (dry seeds) ranging between 300 and 800 kg/ha in traditional farming and may exceed 3000 kg/ha in intensive farming (Abubakar and Abdou, 2009).

Chili pepper (*Capsicum frutescens* L.) is a fruit type vegetable of tropical and subtropical important versatile spicy crop used as ingredient in foods. It also possess potential applications in traditional medicine, perfumery, preservatives and insecticides (Raja and Sethuvanian, 2008; Rosulu *et al.,* 2022). Given the increasing costs and environmental concerns associated with synthetic insecticides, intercropping bambara groundnut with chilli pepper offers a promising, low-input alternative for pest suppression, but empirical data on optimal patterns are scarce. Thus, the objective of this study was to assess the mixture of bambara groundnut and chilli pepper with particular reference to cropping pattern and insect pest management in Southwestern Nigeria.

Materials and Methods

Experimental site

The field experiment was conducted at the Teaching and Research Farm of Yaba College of Technology, Odoragushin, Epe Campus during the wet season of 2022. The site lies between Longitude $3^{0}58'05"$E and Latitude $6^{0}38'03"$N above sea level (GPS coordinates) on kilometer 16, Epe-Ijebu Ode Road, Epe, Lagos in the lowland rainforest vegetation zone within South-Western Nigeria with an annual rainfall of 1506.6 mm as reported by Rosulu *et al.,* (2022). The soil was of sandy loam textural class.

Experimental materials

Bambara seeds was purchased from International Institute of Tropical Agriculture (IITA), Ibadan while chilli pepper seeds were obtained from Lagos State Input Supply Company (LIASCO), Epe depot. The chilli pepper was prepared for sowing in nursery trays for 6 weeks and dressed with Acti-seeds (inoculum of mycorrhizal fungi) seed dresser to guide against soil borne diseases according to methods described by Rosulu *et al.,* (2022).

Field Layout

The site was cleared, stumped and the debris packed away. Thereafter it was ploughed, harrowed and ridges prepared for planting of chilli pepper seedlings (raised in the nursery for 5 weeks) and bambara groundnut seeds (planted at 2 seeds per hole) following the methods described by Amatobi (2000), Oparaeke (2005) and Rosulu *et al.,* (2022). Spacing for intercropping of chilli pepper and bambara groundnut was 60cm x 45cm while that of sole cropping of bambara groundnut was 25cm apart at 2 seeds per hole.

12 experimental plots were demarcated on a diameter of 5m x 3.75m each with 5 ridges (totaling 60) and 0.7m apart. Interspaces between adjacent plots and blocks were 1.5m. Thus, the net plot for data collection was 18.75m^2 while the gross plot size was 474.38m^2.

The experiment was laid out in a Randomized Complete Block Design (RCBD) with 4 treatments at 3 replications arranged as follows:

i. Alternate Intercropping of chilli pepper and Bambara groundnut
ii. Strip cropping (chilli pepper and Bambara groundnut)
iii. Border cropping (chilli pepper and Bambara groundnut)
iv. Sole cropping of Bambara groundnut

Data collection

Data on bambara groundnut were collected based on the following parameters:

i. Growth parameters of Bambara groundnut at 2, 4 and 6 weeks after planting

20 plants per plot were selected and tagged. The number of leaves were visually counted at 2, 4 and 6 weeks after planting while plant height was measured in centimeter (cm) using tape rule from ground level to the apical bud from 20 stands per plot selected randomly from middle rows where crop component interactions were assumed to be highest.

ii. Pest population

Pest population was sampled very early in the morning (6:30am – 9:00am) when the insect pest were less active at 2 and 10 weeks after planting. Visually counted insects were recorded using direct method that enables quantitative estimation of pest incidence for bambara groundnut using the Tilton formular as enunciated by Okunlola *et al.,* (2008) and Rosulu *et al.,* (2022).

$$\text{Efficacy (\%)} = 1 - [\frac{T_a}{C_a} \times \frac{sC_b}{T_b}] \times 100$$

Where: T_a = Infestation in the treated plot after application

C_a = Infestation in the check plot after application

T_b = Infestation in the treated plot before application

sC_b = Infestation in the check plot before application

iii. Assessment of thrips (*Megalurothrips sjostedti*) and Legume pod borer (*Maruca vitrata*)

Assessment of thrips and pod borers were accomplished by removing 20 flowers from plants in each plot. The flowers were sampled between 0800 and 1030h to minimize loss of thrips flying off after disturbance (Ngakou *et al.,* 2003), they were placed in vials containing 30% alcohol and taken to the labouratory where the flowers were dissected the next day according to methods described by Ahmed *et al.,* (2009) and Rosulu *et al.,* (2022). The number of thrips and legume pod borers found were counted separately under a binocular stereomicroscope and recorded.

iv. Assessment of legume pod borer (*Maruca vitrata*) and pod sucking bugs (*Clavigralla tormentosicollis*)

Sampling for borers and pod sucking bugs were done using the direct count method (as described by Olatunde *et al.,* (1999) and eunuciated by Nampala *et al.,* (1999)) by carefully walking along 2 middle rows of each plot, counting and recording the number of bugs seen.

v. Pod damage:

At plant maturity, shrivelling, twisting, stunting and constriction were assessed by counting the number of damaged pods per plant and divided by the total number of pods produced per plant in a random sample of 20 plants per plot. This was expressed in % by multiplying by 100 as described by Rosulu *et al*.,(2022).

vi. Grain Yield

Grain yield was recorded from each plot after harvesting (at maturity), threshing and winnowing by weighing all the seeds from the 20 sampled plants per plot. Grain yield data was converted to kg/ha before ANOVA using the following formulas (Rehaja, 1976) as enunciated by Rosulu *et al.,*(2022).

$$\text{Yield (kg/ha)} = \frac{a \; x \; 10{,}000}{b \; x \; 10{,}000}$$

Where: a = plot yield

b = net plot size

vii. Yield loss

Yield loss was calculated using the Judenko, (1973) formula of assessing yield loss on the field as enunciated by Rosulu *et al.,* (2022):

$$AL = (a - b) \times NAT$$

Where: AL = Actual loss

a = mean yield of unattacked plant

b = mean yield of attacked plant

NAT = Number of attacked plant

Data analysis

All data were obtained in triplicate and subjected to two way ANOVA using SPSS version 16.0. The means were separated using Tukey Comparison at 5% probability level.

Results

Effect of intercropping of bambara groundnut and chilli pepper on growth parameters at 2, 4 and 6 weeks after planting (WAP)

Effect of intercropping of bambara groundnut and chilli pepper on growth parameters at 2, 4 and 6 weeks after planting (WAP) is presented in Table 1. Higher number of leaves at 2, 4 and 6 weeks were recorded in strip cropping (16.93±1.65, 27.97±2.86, 39.00±5.63) as compared to other cropping patterns.

With respect to plant height, the values were not statistically different. The highest plant height (cm) at 2, 4 and 6 weeks were obtained in sole cropping (16.00±1.04) compared to other cropping patterns while the lowest values were recorded in strip cropping (5.03±1.04) and alternate cropping (5.97±1.04).

Table 1: Effect of intercropping of bambara groundnut and chilli pepper on growth parameters at 2, 4 and 6 weeks after planting (WAP)

Treatments	Growth Parameters					
	Number of leaves			Plant Height (cm)		
	2 weeks	4 weeks	6 weeks	2 weeks	4 weeks	6 weeks
ALT CRP R_1	16.80±1.65^{a}	23.80±2.86^{ab}	36.60±5.63^{a}	5.97±1.04^{b}	8.17±0.67^{ab}	8.30±1.05^{a}
ALT CRP R_2	16.43±1.65^{a}	26.87±2.86^{ab}	40.57±5.63^{a}	6.60±1.04^{b}	9.51±0.67^{a}	10.27±1.05^{a}
ALT CRP R_3	16.77±1.65^{a}	28.77±2.86^{ab}	40.63±5.63^{a}	6.53±1.04^{b}	9.35±0.67^{ab}	10.27±1.05^{a}
STR CRP R_1	16.30±1.65^{a}	22.10±2.86^{b}	35.33±5.63^{a}	5.03±1.04^{b}	8.65±0.67^{ab}	8.33±1.05^{a}
STR CRP R_2	16.93±1.65^{a}	27.97±2.86^{ab}	39.00±5.63^{a}	6.43±1.04^{b}	8.62±0.67^{ab}	10.40±1.05^{a}
STR CRP R_3	16.20±1.65^{a}	29.70±2.86^{ab}	39.00±5.63^{a}	6.50±1.04^{b}	9.31±0.67^{ab}	10.40±1.05^{a}
BOR CRP R_1	14.27±1.65^{a}	22.33±2.86^{b}	37.27±5.63^{a}	5.73±1.04^{b}	8.43±0.67^{ab}	10.93±1.05^{a}
BOR CRP R_2	15.23±1.65^{a}	24.53±2.86^{ab}	34.93±5.63^{a}	5.47±1.04^{b}	9.81±0.67^{a}	10.57±1.05^{a}
BOR CRP R_3	14.47±1.65^{a}	23.97±2.86^{ab}	34.23±5.63^{a}	6.21±1.04^{b}	8.41±0.67^{ab}	10.53±1.05^{a}
SOL CRP R_1	15.37±1.65^{a}	24.53±2.86^{ab}	50.37±5.63^{a}	7.63±1.04^{b}	6.97±0.67^{b}	9.70±1.05^{a}
SOL CRP R_2	15.93±1.65^{a}	32.90±2.86^{a}	41.63±5.63^{a}	6.63±1.04^{b}	8.45±0.67^{ab}	10.23±1.05^{a}
SOL CRP R_3	6.63±1.65^{b}	28.43±2.86^{ab}	40.30±5.63^{a}	16.00±1.04^{a}	8.55±0.67^{ab}	9.30±1.05^{a}

Values represent least square means (LS-means) ± standard error. LS-means were separated using Turkey-Kramer Comparison and LS-means within a column followed by different letters are significantly different at P≤0.05.
ALT CRP= alternate cropping, STR CRP= strip cropping, BOR CRP = border cropping, SOL CRP = sole cropping.

Table 2: Effect of intercropping of bambara groundnut and chilli pepper on thrips, legume pod borers, legume pod borer and pod sucking bugs

Treatments	No. of Thrips	No. of LPB	Nymph LPB	Adult LPB	Nymph PSB	Adult PSB
ALT CRP R_1	4.00±1.09^{bc}	2.36±0.35^{bcd}	1.31±0.10^{d}	1.26±0.10^{cde}	1.24±0.11^{d}	1.25±0.11^{ef}
ALT CRP R_2	3.33±1.09^{c}	1.90±0.35^{cd}	1.33±0.10^{cd}	1.13±0.10^{de}	1.27±0.11^{d}	1.33±0.11^{def}
ALT CRP R_3	4.67±1.09^{abc}	1.76±0.35^{d}	1.12±0.10^{d}	1.08±0.10^{e}	1.44±0.11^{cd}	1.18±0.11^{f}
STR CRP R_1	4.33±1.09^{bc}	3.24±0.35^{ab}	1.95±0.10^{ab}	1.72±0.10^{ab}	1.91±0.11^{b}	1.82±0.11^{abc}
STR CRP R_2	5.00±1.09^{abc}	2.70±0.35^{abcd}	1.71±0.10^{b}	1.48±0.10^{abcd}	2.08±0.11^{b}	1.62±0.11^{bcde}
STR CRP R_3	5.33±1.09^{abc}	2.37±0.35^{bcd}	1.70±0.10^{b}	1.37±0.10^{bcde}	1.69±0.11^{bc}	1.46±0.11^{cdef}
BOR CRP R_1	5.33±1.09^{abc}	3.54±0.35^{ab}	1.84±0.10^{ab}	1.45±0.10^{abcd}	2.03±0.11^{b}	1.79±0.11^{abc}
BOR CRP R_2	6.00±1.09^{abc}	3.03±0.35^{abc}	1.70±0.10^{b}	1.56±0.10^{abc}	1.91±0.11^{b}	1.65±0.11^{acbde}
BOR CRP R_3	6.33±1.09^{abc}	2.80±0.35^{abcd}	1.69±0.10^{bc}	1.48±0.10^{abcd}	1.78±0.11^{bc}	1.63±0.11^{bcde}
SOL CRP R_1	7.00±1.09^{abc}	3.74±0.35^{a}	2.08±0.10^{a}	1.79±0.10^{a}	2.56±0.11^{a}	1.72±0.11^{abcd}
SOL CRP R_2	8.33±1.09^{a}	3.36±0.35^{ab}	1.91±0.10^{ab}	1.71±0.10^{ab}	2.08±0.11^{b}	2.04±0.11^{ab}
SOL CRP R_3	7.33±1.09^{ab}	3.04±0.35^{abc}	1.87±0.10^{ab}	1.61±0.10^{abc}	1.88±0.11^{b}	2.07±0.11^{a}

Values represent least square means (LS-means) ± standard error. LS-means were separated using Turkey-Kramer Comparison and LS-means within a column followed by different letters are significantly different at P≤0.05.
ALT CRP= alternate cropping, STR CRP= strip cropping, BOR CRP = border cropping, SOL CRP = sole cropping, No. Thrip = number of thrips, No. LPB = number of legume pod borer, NYMPH LPB – nymph of legume pod borer, ADULT LPB = adult of legume pod borer, NYMPH PSB = nymph of pod sucking bug, ADULT PSB = adult of pod sucking bug

Table 3: Effect of intercropping of bambara groundnut and chilli pepper on pest population

Treatments	Pest Population at 2 WAP	Pest Population at 10 WAP
ALT CRP R_1	0.00±0.21^{f}	0.00±0.49^{c}
ALT CRP R_2	4.15±0.21^{de}	2.33±0.49^{ab}
ALT CRP R_3	3.91±0.21^{e}	1.33±0.49^{bc}
STR CRP R_1	0.00±0.21^{f}	0.00±0.49^{c}
STR CRP R_2	4.35±0.21^{cde}	2.67±0.49^{ab}
STR CRP R_3	4.35±0.21^{cde}	2.00±0.49^{ab}
BOR CRP R_1	0.00±0.21^{f}	0.00±0.49^{c}
BOR CRP R_2	5.13±0.21^{b}	3.33±0.49^{a}
BOR CRP R_3	4.69±0.21^{bcd}	2.00±0.49^{ab}
SOL CRP R_1	0.00±0.21^{f}	0.00±0.49^{c}
SOL CRP R_2	6.24±0.21^{a}	3.67±0.49^{a}
SOL CRP R_3	5.06±0.21^{bc}	2.67±0.49^{ab}

Values represent least square means (LS-means) ± standard error. LS-means were separated using Turkey-Kramer Comparison and LS-means within a column followed by different letters are significantly different at P≤0.05. ALT CRP= alternate cropping, STR CRP= strip cropping, BOR CRP = border cropping, SOL CRP = sole cropping

Table 4: Effect of intercropping of bambara groundnut and chilli pepper on pod damage, grain yield and yield loss

Treatments	Pod Damage	Grain Yield	Yield Loss
ALT CRP R_1	5.67±1.23^{c}	21.36±12.99^{b}	336.63±9.41^{c}
ALT CRP R_2	6.33±1.23^{c}	27.05±12.99^{b}	330.13±9.41^{c}
ALT CRP R_3	6.33±1.23^{c}	36.78±12.99^{b}	299.58±9.41^{c}
STR CRP R_1	8.00±1.23^{bc}	9.25±12.99^{b}	327.92±9.41^{c}
STR CRP R_2	8.00±1.23^{bc}	11.75±12.99^{b}	341.75±9.41^{c}
STR CRP R_3	7.33±1.23^{bc}	14.43±12.99^{b}	343.20±9.41^{c}
BOR CRP R_1	6.67±1.23^{bc}	14.48±12.99^{b}	347.48±9.41^{bc}
BOR CRP R_2	8.00±1.23^{bc}	18.29±12.99^{b}	335.57±9.41^{c}
BOR CRP R_3	7.33±1.23^{bc}	22.30±12.99^{b}	336.87±9.41^{c}
SOL CRP R_1	11.00±1.23^{ab}	28.48±12.99^{b}	442.32±9.41^{a}
SOL CRP R_2	11.00±1.23^{ab}	38.26±12.99^{b}	417.70±9.41^{a}
SOL CRP R_3	15.33±1.23^{a}	100.24±12.99^{a}	395.27±9.41^{ab}

Values represent least square means (LS-means) ± standard error. LS-means were separated using Turkey-Kramer Comparison and LS-means within a column followed by different letters are significantly different at P≤0.05.
ALT CRP= alternate cropping, STR CRP= strip cropping, BOR CRP = border cropping, SOL CRP = sole cropping.

Effect of intercropping of bambara groundnut and chilli pepper on thrips, legume pod borers, legume pod borer and pod sucking bugs

Bambara groundnut intercropping with chilli pepper proved to be effective in reducing the insect populations as there was significant difference ($P < 0.05$) between the intercropped and sole cropping plots as shown in table 2. The intercropped plots had lower number of thrips and legume pod borer than the control plots. Sole cropping had the highest number of thrips (8.33±1.09) and legume pod borer (3.74±0.35) respectively while alternate cropping had the lowest number of thrips (3.33±1.09) and legume pod borers (1.76±0.35) respectively.

However, the number of nymph and adult of pod sucking bugs in the intercropped plots were significantly ($p < 0.05$) lower compared with the untreated plots. Sole cropping had the highest number of nymph and adult pod sucking bugs (2.56±0.11) and (2.07±0.11) respectively.

Effect of intercropping of bambara groundnut and chilli pepper on pest population

The result for effect of bambara groundnut and chili pepper cropping system on the pest population of Bambara groundnut are shown in table 3. It showed that sole plots had significantly higher number of pest population when compared to the intercropped plots. Specifically, sole cropping had the overall highest pest population (3.67±0.49) while alternate cropping had the lowest pest population (1.33±0.49).

Effect of intercropping of bambara groundnut and chilli pepper on pod damage, grain yield and yield loss

The effect of bambara groundnut and chilli pepper cropping systems on pod damage, grain yield and yield loss were significantly different ($P < 0.05$) (Table 4). The highest rate for pod damage reduction was recorded for alternate cropping (5.67±1.23) while sole cropping had the lowest reduction of pod damage (15.33±1.23). Sole cropping had the highest value for grain yield (100.24±12.99) while strip cropping had the lowest grain yield. Yield loss was highest in sole cropping (442.32±9.41) and lowest in alternate cropping (299.58±9.41).

Discussion

Comparable to this study, the practicability and efficacy of intercropping has been reported in numerous studies (Manga *et al.,* 2003; Fersia-Djidjonri *et al.,* 2021; Rosulu *et al.,*2022). This ranges from reduction in populations of

several pests, increase in yield, reduction in risk of total crop failure (due to pests and disease attack), remedial control in adverse weather condition to efficient use of land and other inputs. A complex series of inter and intra-specific interactions guided by modifications and uses may have contributed to this particularly light, water, nutrient and enzymes particularly on cereals and legumes (Fersia-Djidjonri *et al.,* 2021). Thus, many plants have the ability to modify the rhizosphere pH and improve the availability of nutrients such as phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg) which are in unavailable form (Dakora and Muofhe, 1995 in Fersia-Djidjonri *et al.,* 2021).

Close scrutiny on the presence of insect pests on bambara groundnut in both mixed and pure stands revealed the presence of insects such as leafhoppers (*Hilda patruelis* and *Empoasca facialis*), foliage beetles (*Oetheca mutabilis*), larvae of *Diacrisia maculosa*, thrips, pod borers and pod sucking bugs (*Clavigralla tomentosicollis*) as key pests. This is consistent with the report of Oyewale *et al.,* (2023) while quoting Mabika and Mafongoya (1997) and Swanevelder (1998) affirmed that, few insect pests that have been reported to attack Bambara groundnut include groundnut leafhoppers (*Hilda patruelis* Stal.), the larva of *Diacrisia maculosa* L. and *Lamprosema indicate* F. while *Piezotrachelus ugandum* L. and *Rivella spp.* (causes damage on developing pods and root nodules) and termites (attacking pods in dry weather) respectively.

However, there were significant reduction in number of insects in intercropped situation (particularly alternate intercropping) when compared to control. This is similar to that given by Rosulu *et al.,* (2022) who reported significant lower number of insect pests in cowpea intercropped with chilli pepper and Ogah *et al.,* (2012) who discovered higher grain yields of maize and lower number of insects when intercropped with Bamabra groundnut compared to maize in monoculture. The higher seed yield recorded in maize associated with cowpea compared to other intercropping shows the importance of legumes when growing in combination with cereals (Fersia-Djidjonri *et al.,* 2021). Here, chilli pepper may have acted as attractant plants which will decrease pest damage to major crop (Bambara groundnut). This is consistent with the findings of Rosulu *et al.,* (2022) that chilli pepper may have acted as a barrier or trap crop thereby reducing their infestation on cowpea plants and do not impair its yield. Similar report by Jing *et al.,* (2021) also revealed that maize intercropped with other plants help to reduce the abundance of Fall Armyworm (FAW). Also, Hailu *et al.,* (2018) in Jing *et al.,* (2021) while comparing monocultured maize, intercropped with leguminous crops of bean (*Phaseolus vulgaris*), soybean (*Glycine max*) and groundnut (*Arachis hypogea*) reported significant deacrese in fall armyworm attack by up to 40%. Additionally, Jing *et al.,* (2021) reported intercropping with marigold (*Tagetes erecta*) and border intercropping with Napier grass (*Pennisetum purpureum*) as effective for sustainable management of FAW. Ditto for groundnut when row mixture groundnut and common beans in separate rows are intercropped for the control of aphids (*Aphis craccivora*) where common beans sticky tendrils kept aphids away giving a reduction in aphids by decreasing forage time (Farrel, 1976; Mohd *et al.,* 2022) as well as use of cotton as trap crop for the control of *Heliothis spp* in cowpea intercrop situation (Mohd *et al.,* 2022). From the foregoing, one could infer that, pests are lesser in intercropped plots than in mono crops. Thus, by increasing crop diversity within a given agro-ecosystem, intercropping has a potential to serve as a cultural practice based strategy for pest management by lowering the insect population and the frequency with which it attacks individual plants (Mohd *et al.,* 2022).

Conclusion and Recommendation

Intercropping system, which is popularly practiced in the humid and sub-humid regions has been shown to be more efficient than sole cropping. One of the reason for this is the possibility of reducing the incidence of pests and diseases. Yet, intercropping studies and concepts have been relegated to background in the developed countries where planting and harvesting are largely done mechanically.

Nigeria is the largest producer of bambara groundnut and chilli pepper in Africa, accounting for about 50% of the African production, while bambara groundnut is essentially for human consumption with the seed making a complete food as it contains sufficient quantities of protein, oil and carbohydrates. The fruits of chilli pepper are used as vegetables and spices for food and in treatment of some ailments. They can be intercropped with cereals, vegetables, other legumes and tuber crops. Thus, their importance as a component crop in many cropping system combinations in Africa cannot be overemphasized.

This study highlights the importance of alternate intercropping of bambara groundnut with chilli pepper as higher in ranking than other cropping system in terms of higher grain yield, reduction in yield loss and pest infestation. Thus, under local conditions, this is a rational strategy as there is a greater stability, profitability and sustainability in crop production over different seasons, better use of land resources and afford the farmer to harvest different crop produce for use and sale. Therefore, the alternate intercropping system is greatly encouraged for the adoption of poor resource or peasant farmers constrained with the technicalities involved in the application of synthetic insecticides and its high cost and the technicalities involved in the ration of chilli pepper extract being a non-capital intensive and uncomplicated method of control. Building on this findings, it would be useful to determine the Land Equivalent Ratio (LER) as it is obvious that the highest net revenue for the total system will be generated and give overall LER values greater than one.

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