

Effect of Pepper and Cereals Intercropping in the Management of Aphids (*Aphis gossypii* Glove) on Pepper (*Capscium annum* L.)

Degri, M M.¹, Ayuba, J.²

1.Department of Agronomy, Faculty of Agriculture, Federal University, Kashere, PMB 0182 Gombe, Nigeria

2.Department Of Biological Sciences, Faculty of science, Gombe State University, Gombe, Nigeria

ABSTRACT

Field experiments were conducted at the teaching and research farm of Federal College of Horticulture Dadin kowa during 2011 and 2012 cropping seasons to assess the effect of pepper-cereals intercropping on aphids infestation and damage on pepper. A randomized complete block design was used to test the intercropping of pepper+maize, pepper+millet, pepper+sorghum and a sole pepper. The results obtained showed that pepper+maize and pepper+millet combinations significantly ($P \leq 0.05$) reduced aphids infestation, improved pepper growth and enhanced its yield. These combinations were effective in reducing aphids infestation and damage because the companion cereals served as a successful barrier in checking and trapping aphids on pepper. This cultural control method for controlling aphids on pepper in the field is highly recommended to overcome pollution, health hazards and residual effects associated with insecticides usage.

Keywords: Pepper, Cereal, Intercropping, Monocrop, aphids

INTRODUCTION

Intercropping is the cultivation of two or more crops at the same time in the same field. A wide range of crops in Africa can be used for intercropping (George and Jeruto, 2010, Ijoyah, 2012). Monocropping on the other hand is often highly productive and efficient, but criticized for their genetic uniformity and increased pest and disease susceptibility (Andow, 1991, Hussein and Samad, 1993, Blackman and Eastop, 2000). The importance of plant diversity in cereals and maize agro ecosystem in reducing insect pests of pepper has been recognized in sub-Saharan Africa (Hussein and Samad, 1993; Fajinmi and Fajinmi 2006). Studies by some researchers reported that pepper intercropped with non-host plant have significantly lowered aphids infestation and damage, hence resulted in higher yield than monocrop (Midmore *et al.*, 1995; Ashenafi *et al.*, 2014). Hugar and Palled (2008) and (Ram and Singh, 2010) reported that intercropping creates an unsuitable host acting as trap plants, increase mortality due to starvation and or predation of migrating insect pests on non-hosts in the crop mixture and increase parasitism as a result of volatile produced by the intercrop. According to Osipitan *et al* (2012) the main reason for practicing intercropping by poor-resource farmers to monocropping include reduction in pest and disease incidence, increase biodiversity, crop stability, risk spreading, food security, effective use of labour, increased crop productivity and erosion control. Intercropping is one of the cultural control method that is effective in resource management and increased productivity (Trenbath, 1993; Degri and Samaila, 2014).

Pepper is the world second most important vegetable crop after tomato (Tindall, 1983 and Ado, 1990) part of the country where they have good soils and weather that readily supports its growth and production (Ado, 1990 and Idowu, 2010). Pepper crop is prone to many insect pest infestation particularly the devastating cotton Aphids (*Aphis gossypii* Glove) (Homoptera Aphididae) which is a serious pest of pepper in both rainy and dry seasons in Nigeria (Degri, 2013; Fajinmi and Fajinmi, 2006). Aphids are found in many countries with tropical, sub-tropical and temperate climates (Risch *et al.*, 1983, Blackman and Eastop, 2000; Ashenafi *et al.*, 2014). However, its optimum environment lies in areas with higher temperatures like Nigeria. Pepper intercrops with other crops of different canopy significantly influence pepper aphid population density and reduces fruit damage than sole

**Address for correspondence:*

mikedegri@gmail.com

pepper crops (Ram and Singh, 2010). Intercropping pepper proved to create a successful barrier in checking the incidence of aphids on pepper (Hussein and Samad, 1993).

The use of insecticides has the major control measures for insect pests on pepper in Nigeria (Degri, 2013). Since the pepper fruits are eaten in salad, soups and different food preparations, the health and environmental hazards associated with insecticides should be avoided. The use of cultural control method like intercropping systems is a better option to insecticide use. A study on the design and patterns of cereals-pepper intercropping system with respect to aphid control on pepper is worthwhile. This study therefore aims at assessing the effect of pepper-cereals intercrops in reducing the incidence and damage of aphids (*Aphis gossypii*) on pepper in this agro ecological zone of Nigeria.

MATERIALS AND METHODS

The experiments were conducted during 2011 and 2012 rainy seasons at the teaching and research farm of Federal College of Horticulture, Dadin kowa Gombe, situated in the northern Guinea Savannah ecological zone of Nigeria. The treatments consisted of three cereal types namely maize, millet, sorghum each intercropped with pepper crop. The experimental design was a randomized complete block design replicated four times. Plot size was 5.0m by 3.0 m (15.0 m²). An alley of 2.0 m was allowed between the plots.

The seeds of pepper, maize, millet and sorghum were purchased from an input store of Gombe State Agricultural Development Program (GSADP), Bogo, Gombe. The seeds were treated with apron star and sealed in waterproof nylon bags

Pepper seedlings were raised in a shade nursery at the beginning of the raining seasons at the college orchard. The experimental land was cleared of debris, harrowed with tractor out and levelled before sowing or transplanting pepper seedlings were watered four weeks, gently uprooted with their roots covered with soil and transplanted at 50 cm × 60 cm spacing on the prepared plots. Maize, millet and sorghum seeds were planted at the same time with pepper transplanted between the cereals at the seed rate of 2-3 seeds/stand and 25cm spacing. The cereal stands were later at two weeks after planting thinned to two plants/stands. Two weeks after transplanting of pepper seedlings which coincided with the thinning of the cereals, failed stands of both pepper and cereals were filled to maintain all the existing stands. After the filled gaps were established, the plots were weeded and fertilized with NPK 15:15:15. Fertilizer application was done twice to each crop stand at 4 and 7 weeks after planting/transplanting.

Cereals were harvested at 11 WAP, when they were matured while pepper fruits were harvested when the green fruits turned yellow or red.

Data Collection was on the Following:

1. **Number of Aphids/Plants:** The number of aphids were counted visually on five randomly selected and tagged pepper plants in each plot and recorded
2. **Number of Attacked Plants/Plot and Attacked Leaves/Plants:** These data were obtained by visually counting the number of pepper plants and leaves showing the presence of aphids on and recorded.
3. **Plant Height:** The pepper plants were taken every week by measuring each of the five randomly selected and tagged plants from ground level to the apical bud of the plant using metre rule in centimetres commencing from 2WAT to harvest period.
4. **Yield Components**
 - a. **Number of Fruits/Plants:** This data was obtained by virtually counting the number of all fruits per plants from each plot and recorded.
 - b. **Fruits Length:** fruits from the five tagged plants were measured using metre rule in centimetres and recorded.
 - c. **Fruits Yield/Plot:** Data was obtained by harvesting the whole fruits from the plots, weighed and recorded.
 - d. **Fruit Yield/Ha:** Data was obtained by adding up the fruit yields from the different plots and converting it to hectares.

All data collected were subjected to analysis of variance (ANOVA). Significant treatment means were compared and separated using least significant difference (LSD) at 5% level of probability.

RESULTS

Table1 presented the result of pepper-cereals intercropping systems on the number of aphids/plants. Maximum number of aphids were recorded on sole pepper crop (8.46). The number of aphids (*Aphis gossypii*) in pepper-maize (4.12), pepper+sorghum (4.01) and pepper+millet were significantly ($P \leq 0.05$) lower than sole pepper crop. However, pepper and millet intercropping system was significantly different from what obtains in other crop combinations

Crop combination	means number of <i>Aphis</i> spp/plot
Sole pepper	8.46 ^a
Pepper+maize	4.12 ^c
Pepper+millet	6.98 ^b
Pepper+sorghum	4.01 ^c
LSD(0.05)	1.30

Mean values with different alphabet along the column are significantly different from each other at $P \leq 0.05$

Table2 shows the mean plant height of pepper in the different crop combinations and sole pepper crop. Sole pepper had the lowest plant height (18.30) pepper + millet had moderate plant height (21.56cm) while pepper + maize (28.60) and pepper + sorghum (28.44cm) had significantly highest pepper plant height.

Table2. Mean pepper plant height in pepper cereals intercropping system

Crop combination	mean plant height (cm)
Sole pepper	18.30 ^c
Pepper +maize	28.60 ^a
Pepper +millet	21.56 ^b
Pepper + sorghum	28.44 ^a
LSD(0.05)	2.02

Mean values with different alphabet along the column are significantly different from each other at $P \leq 0.05$

Results presented in Table3 show that there were significantly ($P \leq 0.05$) higher number of attacked plants (5.3) and leaves (18.5) on sole pepper crop, pepper + maize and pepper+sorghum intercrops had significantly lower number of attacked plants and leaves while pepper + millet had moderate attacked plants and leaves during the steady period.

Table3. Mean number of attacked plants/plot in pepper and cereals intercropping systems

Crop combination	No. of attacked plants/plot	No. of attacked leaves/plant
Sole pepper	5.3 ^a	18.5 ^a
Pepper+maize	1.5 ^c	3.9 ^b
Pepper+millet	2.6 ^b	3.1 ^c
Pepper+sorghum	1.08 ^c	4.1 ^b
LSD(0.05)	1.03	1.07

Mean values with different alphabet along the column are significantly different from each other at $P \leq 0.05$

Sole pepper plots had significantly lower number of fruits/plants (15.90) lower fruits length (4.11cm) lower fruit yield/plot (3.38kg) and fresh fruit yield (5.69t/ha) (Table4). However, the different pepper-cereals intercropping systems had higher number of fruit, fruit length, fruit yield and total fresh fruit yield. The results showed that pepper+maize and pepper + sorghum were better than pepper+millet in terms of pepper yield components.

Table4. Mean yield components of pepper in pepper-cereal intercropping systems.

Crop combination	No. of fruits/ plants	fruit length(cm)	fruit yield/plot	fruit yield (t/ha
Sole pepper	15.90 ^c	4.11 ^b	3.38 ^b	5.69 ^c
Pepper+maize	23.67 ^a	5.23 ^a	8.01 ^a	11.98 ^a
Pepper+millet	21.84 ^b	5.31 ^a	6.98 ^{ab}	9.52 ^b
Pepper+sorghum	24.03 ^a	5.01 ^a	7.59 ^a	12.30 ^a
LSD(0.05)	2.20	0.48	1.03	0.91

Mean values with different alphabet along the column are significantly different from each other at $P \leq 0.05$

DISCUSSION

Plant bio-diversity is highly efficient in reducing pests' incidence, increasing crop stability and productivity. Pepper and cereal intercropping system in this study indicates the importance of reducing aphids (*Aphis gossypii*) incidence and damage. There were lower number of *A.gossypii* on pepper and cereals intercropping system. This implies that multi cropping system reduce insect pest numbers (Andow, 1991; Risch *et al.*, 1983;Thies and Tschardtke, 1999). Ashenafi *et al* (2014) reported that intercropping of pepper with maize significantly reduced aphids population, increased marketable fruits yield and reduced unmarketable fruit yield. The number of aphids were higher in the sole pepper plot than in the intercropped pepper this is similar to the results of the Degri and Samaila (2004) who reported that fruit borer larva were found minimum when tomato was intercropped and maximum in sole crop tomato. The mechanism responsible for this reduction of aphids number on pepper intercrop was due to unsuitable hosts acting as trap plants and barrier resulting to their starvation. The intercropping component crops have some suppressing effects on t6he aphids through the damaged cropping canopy (Hussein and Samad,1993; Fajinmi and Fajinmi,2006; Ashenafi *et al.*, 2014).

Pepper plant height was lower in the sole crop pepper than intercropped pepper because of the higher number of *A.gossypii* that attacked plants and leaves during the study period. This higher *A.gossypii* must have led to leaf curl and stunted growth in the sole crop pepper (Degri,2013). The higher aphids number recorded on sole crop pepper probably affected the photosynthetic activities of the crop than pepper-cereals intercrop (Olasantan and Lucas, 1992; Osipitan *et al.*, 2012; Ashenafi *et al.*, 2014).

More pepper plants and leaves were attacked by the aphids in the sole pepper crop plots than the pepper-cereals intercrop. This is similar to the research work carried by Risch *et al* (1983) who reported that pest population are frequently higher, cause greater damage and cause greater yield losses in monocropping than in a diversified cropping systems. In this study, cereals created a successful barrier in checking the attack of pepper plants and leave hence the lower number of attacked plants and leaves in pepper-cereals intercropping.

In this present study, pepper-cereals intercrop had greatly improved the yield components of pepper. Pepper-cereals mixtures produced significantly higher ($p \leq 0.05$) fruits with higher fruit length compared with sole pepper (Midmore *et al.*, 1995) This implies that aphids did not disturbed the yield components of pepper during the cropping seasons. It showed that the growth and yield components were not affected compared to sole crop pepper plots (Ashenafi *et al.*, 2014, Fajinmi and Fajinmi, 2006). This is similar to the results of an earlier study that reported pepper intercropped with non-host crops lowered aphid infestation and damage resulting to higher fruit yield than monocrop (Hussien and Samad, 1993). Crops diversification such as intercropping is advantageous to the poor-resource farmers that have access to limited synthetic pesticides and other farm inputs. It reduces field pest infestation, damage and enhances farm productivity.

CONCLUSION

This present study showed that diversified cropping system has advantage over monocropping. Pepper-cereals intercropping proved to be effective in reducing aphids on pepper in the field. As such intercropping system is greatly encouraged over monocropping for aphid management in pepper grown in Northern Nigeria. This system being an uncomplicated method of control and not capital-intensive, the practice should be readily adopted by resource poor-farmer in the study area for high value crop like pepper production.

REFERENCES

- Ado,S.G.(1990). Pepper Production Guide. Extension Publication Submitted to the Horticultural Crops Research Programme IAR, Samaru.pp.12
- Andow,D.A.(1991). Vegetation Diversity and Arthropods Population Response. *Annual Review Of Entomology*, 36:561-586
- Ashenafi,M.,Alemayenu, C. and yibrah,B.(2014). Effect of Intercropping on Aphid Vectors and Yield of pepper(*Capscium annum L.*) in Southern part of Ethiopia. *International Journal of Technology Enhancements and Emerging Engineering Research*, 2(6):28-34

Degri, M.M. & Ayuba, J. "Effect of Pepper and Cereals Intercropping in the Management of Aphids (Aphis Gossypii Glove) on Pepper (Capsicum annum L.)"

- Blackman,R.L. and Eastop, V.F.(2000). Aphids on the worlds crops: An identification and information Guide. 2nd ed John Wiley and sons, Chichester, England.
- Clue,A.D. (1993).Companion planting; Intercropping Certain Vegetables enhance their yield so long as you choose companions on the basis of science ,not garden lore , *Flower Garden Magazine*,1:1-3
- Degri,M.M.(2013).Bio-efficacy of Aqueous plant Extracts and Cyperdicot on insect pests Infestation. Growth and yield of sweet pepper (*Capsicum annum L.*) in the dry savannah of Nigeria .*Scientific Research Journal*, 1(4): 12-16
- Degri, M.M. and Samaila, A.E. (2014). Impact of Intercropping Tomato and Maize on the Infestation of Tomato Fruit Borer (*Helicoverpa armigera* Hubner). *Journal of Agricultural and Crop Research*, 2(8):160-164
- Fajinmi, A.A. and Fijinmi,O.B.(2006). Evaluation of pepper intercropped with tall-companion crop in the management of pepper venial mottle poty virus Disease and its vector on cultivated pepper(*Capsicum annum L.*) in Nigeria. *Agricultural Journal*, 5:205-210
- George ,O.and Jeruto,P.(2010). Suatainable horticultural crop production through intercropping. The case of fruits and Vegetable crops: A Review. *Agriculture and Biology Journal of North America* 1(5):1098-1105
- Hugar,H.Y and Palled, Y.B.(2008). Studies on Maize-Vegetable intercropping systems. *Karnataka Journal of agricultural Science*,21:162-164
- Hussein, M. and Samad, N.A.(1993). Intercropping Chili with maize or brinjal tosuppress populations of *Aphis gossypii* Glove and transmission of chilli Viruses. *International Journal of Pest Management* 39:216-222
- Idowu,O.E(2010).Popularity of pepper in the world second most important crop. *Agriculture and Biology Journal of North America* 1(5):1062-1068
- Ijoyah,M.O.(2012). Review of intercropping research:Studies on Cereal-Vegetable based cropping system. *Scientific Journal of Crop Science* 1(3):55-62
- Midmore,D.J. Yang, S., Kleinhenz =, V.,Geens, S., and Tsay, J.(1995). Intercropping chilli peppers with maize. Proceedings of chili peppers production in the Tropics,13-14 October 1992, Kuala Lumpur. Malaysian Agricultural Research and Development Institute(MARDI),Kuala Lumpur,13-51.
- Olasantan,F.O. and Lucas, E.O.(1992).intercropping Maize with crops of different canopy height and similar of different maturities using different spatial arrangements.*Journal of Agricultural Science Technology* 2(1):13-22
- Osipitan,A.A.,Odedina,J.N.,Adigbo S.O.,Fabunmi,T.O., and Afolabi,C.G.(2012). Assessment of insect pest infestation in a Maize-Cassava intercropping. *Nigerian Journal of Plant Protection*, 26(1):190-202
- Ram,S. and Singh,S.(2010).Effects of intercropping of spices, cereals and root crops on the incidence of *Helicoverpa armigera* (Hub) in tomato. *Vegetable science* 37(92):164-166
- Risch,S.J.,Andow, D. and Alheri,M.A.(1983).Agro ecosystem diversity and pest control: data, tentative conclusions and new research directions. *Environmental Entomology* 12:625-629
- Thies, C. and Tschardtke, T. (1999). Landscape structure and Biological control in agro ecosystems. *Science* 285:893-895
- Trenbath.B.R.(1993).Intercropping for the management of pests and disease. *Field Crop Research* 34:381-405)