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Evaluation Of Reduced Rate of Herbicides and Biological Weed Management For Chilli Pepper (Capsicum Annum L) Production At Afaha NSIT, Rain Forest Zone, Nigeria

Timothy Udo Udo Ekpo
PhD, University of Education, Afaha Nsit, Akwa Ibom State, Nigeria

Nse Timothy Ekpo
PhD, University of Education, Afaha Nsit, Akwa Ibom State, Nigeria

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Abstract

A research investigation at the Research Farm of University of Education, Afaha Nsit, Akwa Ibom State was conducted in the 2025 cropping season. The study was to examine the herbicidal suppression of weeds, safety on the growth and yield of chilli pepper (Capsicum annuum) and component crop. The experiment was laid out in a Randomised Complete Block Design (RCBD) with three replicates. Six treatments were used in the study namely 1.5kg ai/ha linuron+Chlobromuron (1.0 and 1.5kg ai/ha), Pendimethalin+Metobromuron (1.0 and 1.5kg ai/ha), Hand-weeded (2x) (control) and Weedy. All herbicidal treatment plots were integrated with vegetable cowpea at 50,000 plants/ha. The data were collected on weed density, dry weed biomass, agronomic characters of pepper and fresh pepper fruits yield and analysed using Analysis of Variance (ANOVA). The means were separated using Duncan Multiple Range Test, at 5% significance level. The pre-test results showed that vegetable cowpea was more tolerance to the herbicidal effects and produced more ground coverage than Ife brown variety hence it was used for the study. The study revealed that hand-weeded treatment produced one of the highest fresh pepper fruit yields/ha but ranked 5th in the monetary net benefit and was 28.5% of the highest net benefit. The weedy treatment reduced fresh pepper fruit yield by 68.2% while pendimethalin+metobromuron at 1.5kg ai/ha reduced fresh pepper fruit yield by 11.7% but produced the lowest weed density and dry weed biomass. The results also showed that linuron+chlobromuron at 1.0kg ai/ha integrated with vegetable cowpea gave one of the best agronomic characters and fresh fruit yield/ha. It also produced the highest monetary net benefit hence it is recommended.

Keywords: Chilli pepper, herbicides, vegetable cowpea, fruit-yield, net benefit.

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1. Introduction

Chilli pepper belongs to the family of solanaceae. Its production is one of the lucrative business enterprises in Nigeria and of course in other producing areas in Africa. Every household needs pepper with varying quantity each day. This qualifies pepper as a vegetable crop of necessity. Nigeria has a suitable climate and adaphic factors for the cultivation of pepper either under rainfed or by irrigation (Funsho, Oluwafemi and Joseph, 2015). The crop attracts

both local and international market demand in many countries of the world (Karmawati, Ardana and Siswanto, 2020).

Nutritionally, green pepper stands out among many local vegetable crops and it is a rich source of vitamin A and C and thus improve the daily food intake of many consumers (Dominic, Akpan and Bayeri, 2017).

In humid rainforest zone of Nigeria, heavy rainfall and wind at the peak of growth and flowering reduce fruits yield of pepper (Dominic et al, 2017). In addition soil fertility decline and weed infestation are also limiting factors for pepper production across Nigeria (Akata, Akpan and Esang, 2020). Despite the production setback, Nigeria contributes nearly half of the continent's total production (Obayelu, et al, 2020) and ranks the third most produced vegetable crops after tomato and onion (Mustapha, et al, 2021).

Weeds constitute a major limiting factor to crop production in Nigeria as control is problematic and expensive (Ekpo, Ndaeyo and Udosen, 2010a). The resource poor farmers who constitute the bulk of pepper growers in Nigeria deploy manual hoe-weeding. This approach is cumbersome, unattractive, the labour is scarce and costly (Ikeh et al, 2012).

Pepper production sometimes deployed chemical method to suppress weed infestation. In Nigeria for example, the recommended doses of herbicide application (Linuron + Chlobromuron and pendimethalin + Metobromuron) in pepper field ranges from 2 – 3kg ai/ha (Karmawati et al, 2020). This high dose is costly and hazardous to both human and environment (Ekpo and Udosen, 2011). Consequently, the use of low input cost for weed control is advocated by many researchers (Udosen et al, 2010 and Ekpo et al, 2010a). Vegetable – cowpea intercropped with cassava kept weed pressure relatively low and sustained cassava yield advantage at the density of 50,000 (Mbah, 2018).

Generally, leguminous crops present a very good opportunity in sustainable and timely maintenance of weed suppression in arable crop production (Etim, Asuquo and Ekpo, 2023). Combination of reduced chemical and efficient cover crop suppressed weeds satisfactory in cassava intercropping system (Ekpo et al., 2010a); and in plantain production (Ekpo and Ekpo, 2023). There is no variety of pepper developed to tolerate weed infestation and low soil fertility. However, quick maturing variety has been developed hence, research on these factors are recommendable (Akata, et al, 2020). Intercropping of vegetable crops with cover crop legume is not a common practice among resource poor farmers in Nigeria. In addition , such combination is scarce with the integration of herbicide on the same cropping system.

Therefore this study was undertaken to evaluate reduced rate of herbicides and biological weed management for chilli pepper production at Afaha Nsit, Rain Forest Zone, Nigeria.

2. Materials And Method

The Experimental Site

The study was conducted in the research farm of University of Education, Afaha Nsit. The area is 30km from Uyo, the capital city of Akwa Ibom State. The state falls within latitude 040321 and 050331N and longitude 070211 and 080251E. The mean annual rainfall is within the range 2334 – 3411mm.

Experimental Design

The experimental design was completely randomized block design with three replicates. The main field covered 2120m2. Each replicate measured 6 x 8m and spaced 1.5m apart. The treatments were:

i. Linuron + Chlobromuron (1.0kg ai/ha).
ii. Ii Linuron + Chlobromuron (1.5kg ai/ha)
iii. Pendimethalin + Metobromuron (1.0kg ai/ha).
iv. Pendimethalin + Metobromuron (1.5kg ai/ha).
v. Pepper planted sole and weeded twice (control).
vi. Pepper planted unweeded (control).

Land Preparation

The land was mechanically cleared, biomass and stumps removed. The land was then tilled uniformly to the depth of 10cm using a tractor coupled with a disc plough on the 5th day of April, 2025.

Soil Analysis

The soil was sampled 15cm deep using auger at 3 metres apart and composited for analysis. The soil PH, organic carbon, organic matter, total N and available P were analysed. The methods used were Bray P1, Walkley and Black procedures, micro Kjedahl and spectrophotometer

Application of Herbicide

Linuron + chlobromuron (1.0kg ai/ha) and another treatment dose (1.5kg ai/ha) were applied according to treatment. Pendimethalin + metobromuron at 1.0kg ai/ha and 1.5kg ai/ha were also applied uniformly before

transplanting of pepper seedlings the following day.

Planting and Cultural Operation

The pepper seedlings were transplanted at 4 weeks after sowing from the nursery beds after rainfall to ease seedlings removal. The planted seedlings were spaced 50 x 50cm. Vegetable cowpea (50,000 plants/ha) were planted 3 per stand and spaced 50 x 40cm and sprayed with herbicides according to the treatment and later thinned to one/stand. This was carried out after the pre-field test with herbicide. Poultry manure at 5tons/ha was applied at 3 weeks after transplanting.

Collection of Weed Data

Weed Studies: Weed data on density were obtained using a quadrat measured 1 x 1m2 and the weeds within the quadrat were counted accordingly. Dry weed biomass was obtained by oven drying the weeds to a constant temperature of 700c. This study was carried out at 4, 6 and 8 weeks after transplanting.

Collection of Data on Cover Crops: Collection of data on the ground coverage for Ife brown cowpea and vegetable-cowpea was carried out at 4, 6 and 8 weeks using a quadrat and expressed in percentage in the pre-field test. The yield (t/ha) of the vegetable-cowpea was then recorded at 4 months after sowing at the experimental site.

Data Collection on Pepper

These data included the plant height, number of leaves/plants, number of branches/plant, stem girth, leaf area/plant and fruit yield per hectare.

3. Data Analysis

Data collected on weed and pepper were analyzed using Analysis of Variance (ANOVA). The treatment means were separated using Duncan's Multiple Range Test at 5% level of probability.

Economic Analysis

Crop partial enterprise budget was developed for each treatment. The gross field benefit (N/ha) was calculated on the prevalent price of pepper fresh fruits and the dried seeds of vegetable-cowpea.

4. Results

The soil physical and chemical properties were analysed and presented in Table 1.0. The textural class was loamy sand with a pH of 5.8 (slightly acidic). The organic carbon content was moderate while the sodium content was low (0.7 cmol/kg-1). The cation exchange capacity (CEC) was moderate as well as the base saturation %.

Table 1.0: Soil Physico-chemical properties of the soil of the experimental site prior to planting.

Soil properties	Values
pH (H_2O 1:1)	5.8
Organic carbon gkg^{-1}	8.41
Total nitrogen gkg^{-1}	0.46
Available Phosphorus ($mgkg^{-1}$)	11.00
Exchangeable Calcium cmol kg^{-1}	1.04
Exchangeable Magnesium cmol kg^{-1}	0.47
Exchangeable Sodium cmol kg^{-1}	0.07
Sand	81.5
Silt gkg^{-1}	8.0
Clay gkg^{-1}	10.5

In the pre-field test, the herbicidal phytotoxic effects on the germination and the early growth of the two varieties of cowpea were observed. The herbicides had no effects on the germination of the two varieties of cowpea. However, within 2–4 weeks after sowing, it was observed that the early growth of Ife brown was injured more than vegetable cowpea by the application of linuron + chlobromuron and pendimethalin + metobromuron at the rate of 1.5kg ai/ha. The injuries observed were temporary and at 5 weeks after sowing, the minor injuries disappeared. None of the varieties were highly injured. However, vegetable cowpea was acceptable for the research.

In the pre-field test, the percentage ground cover of the two varieties of cowpea, namely Ife brown and vegetable cowpea, was observed. The results showed that the percentage ground cover of vegetable cowpea was superior to the other variety at 8 WAS (Weeks After Sowing). Hence, vegetable cowpea was integrated with herbicides in this research.

Table 2.0: Integration of herbicides and vegetable cowpea on weed density (no/m2) and dry weed biomass (kg/ha)

Treatments	Weed Density WAT			Dry Weed Biomass (kg/ha) WAT		
	4	6	8	4	6	8
L + C (1.0kg ai/ha)	13.0[b]	18.4[c]	20.7[c]	21.2[b]	48.8[c]	80.1[c]
L + C (1.5kg ai/ha)	8.5[c]	11.0[e]	13.5[d]	15.0[c]	40.0[d]	61.0[b]
P + M (1.0kg ai/ha)	12.8[b]	16.3[d]	13.6[d]	12.4[d]	41.7[d]	63.1[b]
P + M (1.5kg ai/ha)	8.2[c]	9.8[ef]	11.9[e]	11.8[d]	38.6[e]	42.7[d]
Hand weeded	90.3[a]	89.1[b]	172.7[b]	197.8[a]	104.3[b]	181.4[b]
Weedy	89.9[a]	251.0[a]	309.9[a]	198.5[a]	161.0[a]	235.3[a]

L + C = Linuron plus Chlobromuron, P + M = Pendimethalin plus metobromuron. Means followed by different letters in each column are significantly different from each other using Duncan Multiple Range Test (DMRT).

The weed density and dry weed biomass are shown in Table 2. The results indicated that at 6 and 8 weeks After Transplanting (WAT) and sowing of vegetable cowpea the weed density and weed biomass were least obtained from the application of pendimethalin plus metobromuron (1.5 kg ai/ha). This was followed by linuron plus chlobromuron (1.5 kg ai/ha). Pendimethalin plus metobromuron was more effective in weed suppression than linuron plus chlobromuron at the same rate of 1.0 kg ai/ha. The highest weed density and dry weed biomass were obtained from the weedy treatment followed by the hand-weeded twice.

Table 3.0: Integration of herbicides and vegetable cowpea on the chilli pepper plant height and number of leaves/plant

Treatments	Plant Heights (cm) WAT				Number of leaves/plant WAT			
	4	6	8	10	4	6	8	10
L + C (1.0kg ai/ha)	18.2[ns]	25.0[a]	63.4[a]	69.9[a]	17.3 [ns]	35.3[a]	44.0[a]	58.0[a]
L + C (1.5kg ai/ha)	17.9[ns]	20.9[b]	54.1[b]	67.2[b]	18.2 [ns]	32.1[b]	42.3[b]	56.1[b]
P + M (1.0kg ai/ha)	17.8[ns]	24.9[a]	62.3[a]	70.8[a]	19.0 [ns]	35.1[a]	41.9[b]	56.4[b]
P + M (1.5kg ai/ha)	18.1[ns]	21.8[b]	53.9[b]	67.0[b]	17.8 [ns]	32.9[b]	41.8[b]	54.1[c]
Hand weeded	17.9[ns]	24.6[a]	63.5[a]	70.1[a]	18.6 [ns]	35.0[a]	44.6[a]	58.3[a]
Weedy	18.0[ns]	24.2[a]	49.8[c]	53.2[c]	17.9 [ns]	34.0[a]	39.8[c]	50.5[d]

Table 3 shows the influence of herbicides integrated with vegetable cowpea on pepper plant height and number of leaves/plant. At 4 weeks after transplanting, there was no significant effect on the height and number of leaves/pepper plant. The results showed significant reduction in plant height and number of leaves/plant with the application of pendimethalin plus metobromuron (1.5kg ai/ha) from 6–10 WAT. This significant reduction was followed by the application of linuron plus chlobromuron (1.5kg ai/ha). Hand-weeded treatment produced the highest plant height but was not statistically different from the values obtained from the linuron plus chlobromuron treated plot at 1.0kg ai/ha. The cowpea varieties integrated in the cropping system had no effect on these agronomic characters.

Table 4.0: Effects of Integrating herbicides and vegetable cowpea on number of branches/plant

Treatments	Stem Girth WAT				Number of Branches/plant WAT			
	4	6	8	10	4	6	8	10
L + C (1.0kg ai/ha)	2.20[ns]	2.75 [ns]	3.55 [ns]	3.75 [a]	3.1 [ns]	6.8 [ns]	10.2 [a]	14.3 [a]
L + C (1.5kg ai/ha)	2.24[ns]	2.77 [ns]	3.50 [ns]	3.73 [a]	3.0 [ns]	6.6 [ns]	10.1 [a]	14.2 [a]

P + M (1.0kg ai/ha)	2.21^{ns}	2.76 ^{ns}	3.52 ^{ns}	3.73 ^{a}	3.1 ^{ns}	6.7 ^{ns}	10.1 ^{ab}	14.2 ^{a}
P + M (1.5kg ai/ha)	2.22^{ns}	2.73 ^{ns}	3.49 ^{ns}	3.15 ^{b}	3.0 ^{ns}	6.6 ^{ns}	9.0 ^{b}	13.0 ^{b}
Hand weeded	2.25^{ns}	2.74 ^{ns}	3.56 ^{ns}	3.73 ^{a}	3.2 ^{ns}	6.8 ^{ns}	10.2 ^{a}	14.7 ^{a}
Weedy	2.20^{ns}	2.71 ^{ns}	2.52 ^{ns}	2.90 ^{c}	3.1 ^{ns}	6.6 ^{ns}	8.3 ^{c}	10.2 ^{c}

The effects of integrated herbicides and vegetable cowpea on stem girth and number of branches/plant are shown in Table 4. Stem girth and number of branches/plant were not found to be significantly difference at 4-6 WAT. The least stem girth and the lowest number of branches/plant were obtained from the weedy treatment plot followed by P +M (1.5kg ai/ha). The largest stem girth and the highest number of branches/plant were obtained from the treatment. Plots of hand-weeded and other herbicide treated plots except pendimethalin + metobromuron at 1.5kg ai/ha.

Table 5.0: Effects of Integrating herbicides and vegetable cowpea on pepper leaf area/plant and fresh fruits yield/ha

z	Leaf area/plant WAT				Pepper fresh yield (t/ha) WAT
	4	6	8	10	4 months after transplanting
L + C (1.0kg ai/ha)	39.1^{ns}	58.7^{a}	80.3^{a}	71.0^{a}	15.95^{a}
L + C (1.5kg ai/ha)	38.8^{ns}	57.7^{b}	78.1^{b}	70.6^{a}	15.02^{b}
P + M (1.0kg ai/ha)	40.0^{ns}	57.0^{b}	78.0^{b}	69.4a^{b}	15.0^{b}
P + M (1.5kg ai/ha)	40.1^{ns}	57.1^{b}	76.3b^{c}	68.0^{b}	14.16^{c}
Hand weeded	40.2^{ns}	60.0^{a}	80.5^{a}	70.4^{a}	16.04^{a}
Weedy	40.2^{ns}	55.3^{c}	55.4^{d}	59.2^{c}	5.1^{d}

The effects of integrating herbicides and vegetable cowpea on the leaf area/plant and fresh fruits yield/ha are represented in Table 5.0. The treatments produced no adverse effect on leaf area/plant at 4 WAT. The highest leaf area/plant was obtained from the hand-weeded and linuron plus chlobromuron (1.0 kg ai/ha) treatment plots. The least leaf area/plant was obtained from the weedy treatment plot.

The highest values on fresh fruit yield of chilli pepper (16.4 t/ha) was obtained from the hand-weeded plot but was not found to be significantly different from the value (15.95 t/ha) obtained from the linuron plus chlobromuron (1.0 kg ai/ha) treatment plot (Table 5.0). The treatment (Pendimethalin plus metobromuron (1.5kg ai/ha)) reduced pepper fresh yield by 11.7% compared with the value obtained from hand-weeded treatment plot. The weedy treatment reduced fresh fruit yield/ha by 68.2% and 68.0% compared with hand-weeded and linuron plus chlorbromuron (1.0kg ai/ha) treatments respectively.

Table 6.0: Summary of partial budget analysis/ha in chilli pepper production using herbicides integrated with vegetable cowpea (AKIDI)

Treatments	Average Akidi Seed Yield/ha (kg/ha)	Average chilli pepper fresh fruits yield/ha (t/ha)	Average gross returns (₦) Akidi dry seeds 1kg = N300	Average gross returns (₦) pepper fresh fruits/kg = N600	Total average gross returns (₦) pepper yield plus Akidi	Average total variable cost (₦)	Total average net benefit (₦)	Marginal Rate of Returns (MRR)

L + C (1.0kg ai/ha)	390.1	2.05	117,030	1,230,000	1,347,000	922,000	425,030	0.46
L + C (1.5kg ai/ha)	375.3	2.00	112,590	1,200,000	1,312,590	936,000	376,590	0.40
P + M (1.0kg ai/ha)	389.5	1.98	116,850	1,188,000	1,304,850	940,008	364,850	0.39
P + M (1.5kg ai/ha)	388.2	1.92	116,460	1,152,000	1,268,460	949,000	319,460	0.33
Hand weeded (2x)	-	2.07	-	1,242,000	-	1,121,000	121,000	0.11
Weedy check	-	0.22	-	132,000	-	580,000	-45,800	-0.08

L = Limuron, C = Chlobromuron, P = Pendimethalin, M = Metobromuron

Economic analysis on the pepper production using herbicides integrated with vegetable cowpea is shown in Table 6.0. The results showed that linuron plus chlobromuron (1.0kg ai/ha) produced the highest net benefit followed by the same herbicides at 1.5 kg ai/ha. A loss of ₦45,800 was realized from the weedy treatment.

The hand-weeded ranked 5th in the realization of the net benefit and was 28.5% of the highest net benefit. The hand-weeded treatment could only produce 11 kobo for every ₦1 invested in the business of pepper production against 46 kobo realized from linuron plus chlobromuron integrated with akidi (50,000 plants/ha).

5. Discussion

Weeds continue to be a major threat to crop production and the alternative biological approach for weed suppression in any cropping system is the use of edible but efficient cover crop as profit oriented compared to hand-weeded approach (Ekpo, Udosen and Etim, 2010b).

The herbicide integrated with the legume cover crop reduced weed density and dry weed biomass significantly. This could be attributed to the combined factors namely; the herbicide inhibit the germination of weed seeds while the cover crop smother the weeds and also deprived the weed seeds adequate sunlight for germination as reported by many researchers (Ekpo and Ekpo 2023, Udosen et al. 2010 and Mbah 2018).

Linuron+chlobromuron at 1.0 kg ai/ha and hand-weeded gave the highest pepper plant height, number of leaves/plant and leaf area index. The number of leaves followed the trend of the plant height. These could be as a result of low level of herbicide without being injurious to the crop and also due to the integration of vegetable cowpea as cover crop to prolong weed suppression. Such related findings were reported by Udosen et al (2010), and Ekpo et al (2010a).

However, in many varieties of pepper the plant height and number of leaves/plant are not the attributes for high yield (Umeri, Atusa and Fidelis 2024; Ndaeyo, Utin, Ekpo and Akpan 2017). Hand-weeded and linuron plus chlobromuron (1.0kg ai/ha) treatment plots produced the highest fresh pepper fruit yield/ha. This was attributed to the favourable values obtained on agronomic characters due to non-herbicidal effects on the target crop and component crop. Other treated plots with higher doses of herbicide produced lower values as earlier reported by Ekpo and Ekpo (2023).

The highest net benefit was obtained from the treatment plot of linuron plus chlobromuron (1.0 kg ai/ha); this could be as the result of producing one of the highest fresh pepper fruit yields/ha. In addition, income was accrued from the vegetable cowpea. Similar findings were reported by Ekpo and Ekpo (2025). Integrated weed management option is not only efficient in weed suppression at relatively low cost but also profit oriented when legume cover crop is integrated, hence it is advocated (Ekpo, Ndaeyo, & Udosen, 2010 a)

6. Conclusion

- Hand-weeding in pepper production gave one of the highest fruit yields/ha, but the monetary net benefit was ranked 5th compared with linuron+chlobromuron (1.0 kg ai/ha) integrated with vegetable cowpea (50,000 plants/ha).
- It was concluded that linuron plus chlobromuron (1.0kg ai/ha) integrated with vegetable cowpea produced one

of the best fruit yields and generated the highest monetary net benefit.

- The operation of the pepper production was carried out without manual hand weeding, thus making the production system attractive to the youths.

7. Recommendations

- Linuron plus chlobromuron (1.0kg ai/ha) integrated with vegetable cowpea (50,000 plant/ha) is recommended for pepper growers.
- Agricultural extension services should therefore encourage the farmers to adopt the integration of recommended herbicide with vegetable cowpea (50,000 plants/ha) in order to maximize profit and contribute to national food security.
- A reduced rate of herbicide resulted in drastic reduction of farm input cost and it is therefore recommended.
- The integration of vegetable cowpea into a cropping system generated a source of income and culturally reduces weed suppression on target crop hence it is recommended.

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References

1. Akata, O. R., Akpan, E. A. and Esang, D. M (2020). Effects of empty palm fruits bunch ash and inorganic fertilizer combination on the growth and yield of chilli pepper. AKSU Journal of Agriculture and Food Sciences, 4(2), 42 – 47.
2. Dominic, I. I, Akpan N. M., Bayeri, K. P. (2017). Growth and yield responses of green pepper to manure rates under field and high tunnel conditions. Notulae Sceintia Biologicae 9(1), 138 – 142.
3. Ekpo, T. U. U and Ekpo, N. T. (2023). Economic of plantain production under weed management strategies integrated with organic matter at Afaha Nsit, Akwa Ibom State, Nigeria. Shared Seasoned International Journal of Topical Issues.
4. Ekpo, T. U. U. and Ekpo, N. T. (2025). Influence of vegetable-cowpea on weed biomass and soil nitrogen fertility status in cassava intercrop. International Journal of Innovations in Education Methods, 11(2), 58 – 68.
5. Ekpo, T. U. U. and Udosen U. (2011). Integrated weed management in cassava maize intercrop. Journal of Weed Science Society of Nigeria (39), 19 - 30.
6. Ekpo, T. U. U., Ndaeyo, N. U. and Udosen, U. U. (2010a). Integration of primextra with 'egusi' – melon for weed control in cassava. International Journal of Agriculture, Biotechnology and Ecology 3(3), 48 – 58.
7. Ekpo, T. U. U., Udosen, U. and Etim, G. J. (2010b). Comparison of weed management systems and their profitability in maize production in the rainforest zone, Nigeria. International Journal of National and Applied Science 2(1), 78 – 91.
8. Etim, G. J. Asuquo, L. E. and Ekpo, K. O. (2023). Assessment of weed management strategies for successful farming activities. Shared Seasoned International Journal Topical Issues 9(1), 38 – 48.
9. Funsho, F. E., Oluwafemi, A. B. and Joseph, A. (2015). Comparative evaluation of organic and inorganic manure on sweet pepper performance in two ecological zones of Nigeria. American Journal of Experimental Agriculture 6(5): 305 – 309.
10. Ikeh, A. O., Ndaeyo, N. U, Uduak, I. G, Iwo, G. A., Ugbe, L. A., Udoh, E. L and Effiong, G. S. (2012). Growth and yield responses of pepper to varied poultry rates in Uyo South-eastern Nigeria. Journal of Agricultural and Biological Science 7(9), 735 – 742.
11. Karmawati, E., Ardana, I. K., and Soetopo, D. (2020). Factor affecting pepper production and quality in several production centre. Indonesian Centre of Estate Crops Research and Development J. Tentara Pelaja (1), Bogor 16111.
12. Mbah, E. U. (2018). Sequential cropping effects of vegetable cowpea on cassava in cassava-cowpea intercrop, Umudike, Southeast Nigeria. Weed Science Society of Nigeria, 4(7): 150-156.
13. Mustapha, A. B., Felix, T., Tashiwa, M. C., & Gworgwor, N.A. (2021). Effects of plant population density and methods of weed control on the yield of pepper in Northeastern, Nigeria. Journal of Applied Science and Environmental Management, 25(2), 261 – 267.
14. Ndaeyo, N. U., Utin, A. I., Ekpo, T. U. U. and Akpan, E. A. (2017). Preliminary evaluation of growth and yield performance of some pepper varieties in an ultisol. Nigerian Journal of Agriculture, Food and Environment, 13(4), 108 – 112.
15. Njoku, D. N. and Muoneke, C. O. (2008). Effect of cowpea planting density on growth, yield and productivity of component crops in cowpea/cassava intercropping system. Journal of Tropical Agriculture, Food, Environment and Extension 7(2), 106 - 113.
16. Obayelu, O. A. Adegboyega, O. M., Sowuumi, F. A. & Idiaye, C. O. (2021). Factors explaining postharvest

loss of hot pepper under tropical conditions. International Journal of Vegetable Science, 1 – 9.

17. Udosen, U. U., Tijani-Eniola H., N. U. Ndaeyo and Ekpo, T. U. U (2010). Comparison of chemical and biological weed management and 'egusi' – melon or Pumpkin. Journal of Agriculture, Biotechnology and Ecology 3(3), 27 – 36.

18. Umeri, C.; Atusa, K; and Fidelis, Q. (2024). Evaluation of the growth and yield of three varieties of pepper in Delta State, Nigeria. Admirably Journal of Multidisciplinary Research, 1(2), 261 – 273.