Effect of cucumber (*Cucumis sativus* L.) and maize (*Zea mays* L.) intercropping in the management of melon lady beetle (*Epilachna chrysomelina)* and pumpkin beetle (*Aulacophora* spp)

[1, 2]UKATU, P. O., [2]ASAWALAM, E. F. and [2]EMEASOR, K. C.
[1]Department of Crop Science, University of Calabar, Calabar, Cross River State.
[2]Department of Plant Health Management, Michael Okpara University of Agriculture, Umudike, Abia State.
e-mail: ukatupatrick@unical.edu.ng, ukpat6237@gmail.com

Abstract
Field trials were conducted in 2023 and 2024 planting cropping seasons to evaluate the potency of different planting configurations in cucumber and maize intercrop on the insect-pests and yield of cucumber in Calabar, Cross River State, Nigeria. The trials involved different intercropping configurations (patterns) in Cucumber and maize intercrop to evaluate their efficacies on the insect pest of cucumber; Melon lady beetle (*Epilachna chrysomelina*) and Pumpkin beetle (*Aulacophora* spp). Four varieties of cucumber (Mona Lisa, Murano 2, Nandini 732 and cucumber marketer) and one maize variety (ART -98-SWI) were used in the experiment. The planting configurations used in each of the trials were; 1: 1, 2: 2 and 3:2. The experiment had 13 treatments with sole cucumber cropping as control. The planting of each of the four varieties of cucumber in any of the three planting configurations with maize served as a treatment. The experiment in each year, was laid out in a randomized complete block design and treatments replicated 4 times. The insect pests assessed in the field were; *Epilachna chrysomelina* and *Aulacophora* spp. Data were collected from the field on insect population (*E. chrysomelina* and *Aulacophora* spp), vine length, number of leaves per plant and fruit yield of cucumber and thereafter were subjected to Analysis of Variance using Genstat 8.0 statistical software. The results indicated that cucumber-maize intercropping configuration at 1: 1 as well as 2:2 had lower population density of insect pests of cucumber than that of 3:2 configuration and cucumber sole-cropping. Similarly, in both experiments, cucumber-maize row intercropping configuration at 1:1 (13.92, 13.6 t/ha) as well as 2: 2 (13.27, 13.46 t/ha) had higher yield than that of 3:2 (11.76, 11.26 t/ha) row configuration. These results suggest that intercropping of Cucumber and maize at 1:1 as well as 2:2 is most effective in the management of insect pests of cucumber. Therefore, planting of cucumber and maize using 1:1 as well as 2:2 cropping pattern could be recommended for better control of insect pests and fruit yield of cucumber.

Introduction
Intercropping is the simultaneous cultivation of two or more crops with different cycles and architectures in the same area, with the development accompanying all or part for the main crop's cycle (Bakshi *et al*., 2019). The use of some species in intercropping can provide farmers with additional income, contributing to the phytosociological and entomofauna balance of crops, reducing costs and environmental damage caused by the excessive use of pesticides (Oliveria *et al*., 2018; Ashishi *et al*., 2022; Sun *et al*., 2022). Many researchers have posited that the sum of the relative yields of intercrop is often greater than one (Yu *et al*., 2015; Martin-Guay *et al*., 2018). As the world population is soaring at an alarming rate and is bound to exceed 10 billion by 2050 (Raza *et al*., 2024), there is urgent need for increase in the production capacity and quality of all food produce including cucumber in order to meet up with the growing nutritional demand for food (Saleem *et al*., 2025). Intercropping is one of the approaches that enhance integrative pest management efforts with farming practices in order to sustain soil productivity and crop health while guaranteeing food security and economic viability (Hatt and Doring, 2023).
The approach enhances the efficient use of available resources to promote ecosystem services towards reducing pest pressure and harms of pesticides without reducing yield (Saleem *et al*., 2025). Ecological intensification involves moving away from a simple method of targeting individual pests towards developing an ecological network involving insect pests, their natural enemies and various crop diversification plans (Hatt and Doring, 2025; Saleem et al., 2025).
Intercropping can increase cropping system productivity by enhancing land-use efficiency (Li *et al*., 2020) and can strengthen farm resilience by stabilizing yield against insect pests (Saleem *et al*., 2025). Natural enemy diversity can increase up to 50% in heterogeneous cropping systems in comparison to simpler ones (Saleem *et al*., 2025). Maize and Cucumber have dissimilar insect pests, diseases and architecture, thus making them good components of intercropping in a system (Pitan and Filani, 2014). Intercropping promotes resource complementation /supplementation when diverse flowering species are used and this tend to increase resource availability to natural enemies which increase their density and richness (Huang *et al*., 2019; Saleem *et al*., 2025). It leads to the reduction of the energy-free space but also competition for resources, which tend to increase pest suppression (Alhadidi *et al*., 2018, Gontijo *et al*., 2015). One of the major limiting factor to the profitable production of cucumber is the extensive crop devastation owing to increase insect infestation (Umeh and Ojiako, 2018; Abo-Elmaged *et al*., 2020; Awadalla *et al*., 2020; Pongen *et al*., 2021) which may even result in 100 percent yield loss due to the fact that some of them serve also as vectors of viral diseases (Ammar *et al*., 2016; Shinde *et al*., 2018; Zahedi *et al*., 2019; Mondal *et al*., 2020; Subr *et al*., 2020). Some of the major insect pests of the cucumber included the following: Pumpkin beetles, *Aulacophora* spp (*Aulacophora foveicollis* Lucas, *Aulacophora hilaris* Boisduval, *Aulacophora nigripennis* Motschulsky), Cucumber beetles (*Acalymma vittatum* Fabricius, *Diabrotica undecimpunctata* Howardi Barber), Epilachna beetles (*Epilachna chrysomelina* Fabricius, *E. elaterii*), Fruit flies (*Bactrocera cucurbitae* Coquillet, *B. invadens* Drew,

Tsuruta & White, *Dacus ciliatus* LW), Melon Aphids (*Aphis gossypii* Glover) etc. (Jaharlal *et al*., 2016; Odewole *et al*., 2018; Mondal *et al*., 2020; Adeoti *et al*., 2023; Adeoti *et al*., 2024; Ukatu *et al*., 2025). Some of the major insect pests of maize included; Fall armyworm (*Spodoptera frugiperda* J. S. Smith), stem borer (*Sesamia calamistis* Hampson), Corn worm/earworm or African ball worm (*Helicoverpa armigera* Hubner), Maize aphid (*Rhapalosiphium maidis* Fitch), maize shoot fly (*Atherigona* spp) etc (Regan *et al.,* 2020; Urge *et al*., 2020; Shinde *et al*., 2021; Sudarma *et al*., 2023).

Therefore, intercropping of cucumber with maize provide an opportunity to evaluate their effect on the insect pests of cucumber and its fruit yield.

Thus, the objective of this present study was undertaken to evaluate the effect of planting patterns (configurations) of cucumber – maize intercropping system for the management of insect pests, growth and fruit yield of cucumber.

Materials and Methods

The experiments were carried out in 2023 and 2024 late and early planting seasons respectively in Calabar, Cross River State, Nigeria. Calabar is characterized by a bimodal annual rainfall distribution pattern ranging from 3000-3500mm with a mean annual temperature which ranges from 27ºC to 35ºC and relative humidity of between 75 and 88%.

All the experimental plots used in this study were manually cleared, stumped, raked and tilled with the aid of cutlass, rake and hoe. Four varieties of cucumber (Mona –Lisa, cucumber marketer, Murano 2, Nandini 732) and one variety of maize were used in the experiment. The experiment was laid out in a randomized complete block design with four replications. The configuration or pattern on insect pests of *Cucumis sativus*. The plant configuration (pattern) used in the experiment included: (i) I row of cucumber: I row of maize (1:1) (ii) 2 rows of cucumber: 2 rows of maize (2:2) (iii) 3 rows of cucumber: 2 rows of maize (3:2) (iv) Sole cucumber (control).

The spacing used for the experiment was 75cm x75cm. Each variety of cucumber was intercropped with maize in each of the above 3 planting patterns and control and any of the above configuration constitutes a treatment plot. Thus, the experiment had a total of 13 treatments combinations and this included: (i) Va_1M_1 -Mona-Lisa intercropped with maize at 1:1 (ii) Vm_1M_1- Murano 2 variety intercropped with maize at 1:1 (iii)Vn_1M_1 - Nandini 732 variety intercropped with maize at 1:1 (iv) $V_{01}M_1$ -Cucumber marketer intercropped with maize at 1:1 (v) Va_2M_2 Mona-Lisa variety intercropped at 2:2 (vi) Vm_2M_2 - Murano 2 variety intercropped with maize at 2: 2 (vii) Vn_2M_2 - Nandini 732 variety intercropped with maize at 2:2 (viii)V02M2 – Cucumber marketer variety intercropped with maize at 2:2 (ix) Va3M2 - Mona-Lisa intercropped with maize at 3:2 (x) Vm3M2- Murano 2 variety intercropped with maize at 3: 2 (xi) Vn3M2 - Nandini 732 variety intercropped with maize at 3:2 (xii) V03M2 - Cucumber marketer variety intercropped with maize at 3:2 (xiii) sole cucumber- control.

The plant population density used was 17,778 plants/ha (ie 8,889 plants of cucumber and maize each). The total land area used for this experiment was 85m x 29m (2,465m^2). Each experimental plot measured 6m x 6m (36m^2). Two seeds each of cucumber and maize, respectively were sowed per hole were later thinned to one plant per stand, two weeks after sowing (WAS). Manual weeding was carried out at two weeks after planting (WAP) and subsequently once in every two weeks. There was no herbicide or pesticide application throughout the duration of the trial.

Data collection

The population densities of cucumber beetles, pumpkin beetles and *Epilachna* beetles were obtained by visual counting of the insects on 6 randomly selected plants per plot in the middle rows of the plot. Sampling was done at four weeks after planting (24 days) and subsequently at 2 weekly intervals till fruits attained maturing between 7:00- 9:00am when insects were relatively inactive.

Vine length: One cucumber vine length was randomly measured from each of the six sampled plants using measuring tape and then the average was recorded.

Number of leaves per plant: Determined by counting the leaves in six sampled plants and the average recorded.

Fruit yield: Undamaged fruits harvested from each of the six plants at the middle of each plot were weighed and recorded as weight per plot and the data was later expressed as tonnes per hectare (t/ha).

Data analysis

All data on insect population were transformed using square root transformation ($\sqrt{x+0.5}$) before they were subjected to analysis of variance (ANOVA) using Genstat 8.0 statistical software. Significant mean values were separated using Tukey Honest significant difference at 5% level of probability.

Results

The effect of cucumber – maize intercropping configuration (pattern) on the population of *Epilachna chrysomelina and Aulacophora spp* is presented in Table 1. Results indicated that the different planting pattern of cucumber-maize intercrop had significant ($P<0.05$) effect on the population of *E. chrysomelina* and *Aulacophora spp* (*A. foveicollis, A. hilaris* and *A. nigripennis*) in both years (2023 and 2024).

The intercropping of various cucumber varieties with maize at various row ratio (configuration) namely; 1:1, one row of cucumber and one row of maize (Va_1M_1, Vm_1M_1, Vn_1M_1, $V_{01}M_1$), 2:2; two rows of cucumber and two rows of maize (Va_2M_2, Vm_2M_2, Vn_2M_2, $V_{02}M_2$), 3:2; three rows of cucumber and 2 rows of maize (Va3M2, Vm3M2, Vn3M2, V03M2) had varied population of *E. chyrsomelina* and *Aulacophora spp*.

In both years (2023 and 2024), the intercropping of cucumber with maize at the ratio of 1:1 and 2:2 had significant ($P<0.05$) reduction in the population of *E. chrysomelina* and *Aulacophora spp* respectively, when compared with that of 3:2 irrespective of the variety of cucumber used in the experiment. The intercropping of cucumber with maize irrespective of the planting configuration used had significantly ($P<0.05$) lower population density of *E. chysomelina* and *Aulacophora spp* respectively, when compared with the sole-cropping of cucumber. All the intercropping systems of cucumber with maize at 1:1 was statistically ($P>0.05$) at par with that of 2:2 in terms of the population density of *E. chysomelina* and *Aulacophora spp respectively.*

The effect of cucumber – maize row intercropping configuration on the vine length and number of leaves /plants is presented in Table 2.

The result indicated that row configuration in intercropping of all varieties of cucumber used with maize had significant (P<0.05) impact on the cucumber vine length and number of leaves in 2023 and 2024 planting seasons, respectively. The vine length of all the cucumber varieties intercropped at the configuration of 3: 2 were significantly (P<0.05) longer than their respective configuration at 1:1 and 2:2 in both 2023 and 2024 planting seasons but the vine length of all the intercropped cucumber varieties was significantly (P<0.05) lower than that of cucumber-sole cropping.

The intercrop of cucumber varieties at various configurations did not have significant (P>0.05) impact within a variety of cucumber on number of leaves except the intercrop of Nandini 732 at the intercropping configuration of 3:2 that had significantly (P<0.05) lower number of leaves when compared with its 1:1 configuration. All the intercropped cucumbers had significantly (P<0.05) higher number of leaves than the sole-cucumber cropping at both years. Similarly, in 2024, all the cucumber intercropped at 3:2 configuration had significantly (P<0.05) lower number of leaves when compared with 1:1 and 2:2. The effect of cucumber – maize row intercropping configuration on the yield of cucumber fruits is presented in Table 3.

In both 2023 and 2024 cropping seasons, the cucumber intercrops at 1:1 had significantly (P<0.05) higher fruit yield (t/ha) than that of its 3:2 within all the cucumber varieties intercrop except the intercrop of Mona Lisa and Murano variety in 2023 that were statistically (P>0.05) at par. The fruit yield (t/ha) of Nandini 732 of all the cucumber intercrop in 2023 was significantly (P<0.05) higher than that of cucumber marketer within all intercropping configurations. In 2024, the Nandini 732 and Mona Lisa variety had significantly (P<0.05) higher fruit yield (t/ha) when compared with cucumber marketer variety except at the intercropping configuration of 3:2 when Nandini 732 was significantly (P<0.05) higher than that of cucumber marketer variety.

Discussion

The study had revealed that cucumber-maize intercropping configuration had depressive effect on the population density of insect pests of cucumber. Cucumber-maize intercropping configuration planted at 3:2 had higher population densities of the insect pests than those planted at the ratio of 1:1 and 2:2 and that of sole cucumber. This situation is in conformity with the work of Abad *et al.* (2020) that reported significant reduction in the population of *Helicoverpa armigera* (Hubner) on tomato crop in the planting pattern of 2:2 of tomato- clover intercropping system than that at the planting configuration of 3:2. That position was also supported by the work of Zarei *et al* (2019) that reported reduction in the population density of *Tuta absoluta* when tomatoes was intercrop with Sainfoin at 1: 2 and 2:2 when compared with that of 3:2 configuration and tomatoes monoculture.

These findings indicated that reducing the ratio of cucumber –maize rows in intercrop had an impact on the host finding and colonization of cucumber plants by the insect pests of the crop. This finding is also in conformitywith the study of Tajmiri *et al.* (2017) that indicated that intercropping increased the efficiency of natural enemies.

Intercropping of cucumber-maize in the ratio of 1:1 and 2:2 also had longer vine length and number of leaves than that of the 3:2. This could be a result of favourable conditions provided by the intercropping pattern due to higher population density of natural enemies in 1:1 as well as 2:2 than that of 3:2 (Abad *et al.*, 2020). The cucumber-maize intercropping at the row ratio of 1:1 and 2:2 also had higher cucumber fruit yield than that of the yield from 3:2 but were at par with cucumber sole cropping aside the additional yield obtained from maize as component crop in the intercropping. This indicates the intercropping advantage of cucumber fruit yield in an intercropping system than that of sole cropping of cucumber. This is in conformity with the findings of Zarei *et al.* (2019), and Abad *et al.* (2020), that intercropping of crops at 2:2 gave significantly higher yield of crops than that of 3:2.

Conclusion

Intercropping of cucumber-maize system is an effective means of protecting cucumber crops against insect pests of cucumber for greater productivity of the crop. *Epilachna chyrsomelina* and *Aulacophora spp* population densities were effectively reduced with the 1:1 and 2:2 cucumber-maize intercropping system when compared to 3:2 and cucumber monoculture. Intercropping of cucumber-maize at 1:1 as well as 2:2 had overall advantage of higher productivity than 3:2 intercropping pattern. Planting of cucumber-maize at the ratio of 1:1 as well as 2:2 had better protection of cucumber crops against the infestation of cucumber by the insect pest of cucumber.

References

Abad, M. K. R., Fathi, S. A. A, and Amiri- Besheli, B. (2020). Influence of tomato/ clover intercropping on the control of Helicoverpa amigera (Hubner*). International Journal of Tropical Insect Science.*40: 39-48.

Abo-Elmaged, T. M. (2020). Cucumber Plants Mites: Survey and capacity of certain pesticides against the amplest one, *Tetranychus utricae Koch,* in Assiut area, Upper Egypt. *Egyptians Academy of Journal of Biological Science (A. Entomology)*, 13(3): 237 – 242.

Adeoti, A. O, Filani, C. O., Pitan, O. O. R., Osipitan, A. A., Makinde, E. A. and Joda, A. O. (2024). Insecticidal activity of ten plant extracts on cucumber *Cucumis sativus* (L). Insect pests in a Rain Forest transition zone of Nigeria. *Nigerian Journal of Entomology*, 40(1): 147-155.

Adeoti, A.O, Pitan, O.O.R., Osipitan, A.A. and Makinde, E.A. (2023). Effect of plant spacing on the density of cucumber insect pests on two cucumber (*Cucumis sativus L.*) varieties. *Nigerian Journal of Horticultural Science*, 27(1): 106-115.

Alhadidi, S. N., Griffin, J. N. and Fowler, M. S. (2018). Natural enemy composition rather than richness determines pest suppression. *Biological Control*, 63:575-584.

Ammar, M. I. and Abolmaaty, S. M. (2016). Effect of different colors Mulch in population density of some pests infesting cucumber plants and on cucumber field. *Egyptian Academy, Journal of Biological Science (A. Entomology)*, 9(4): 153 – 162.

Ashishi, K., Jnasnesha, R. K. and Dubey, B. K. (2022). Intercropping and mixed herb distillation for high-quality oil yield using lemon-scented basil *(Ocimum africanum* Lour*)* cv. CIM-Jyoti and lemongrass (*Cymbopogon flexuousus) (Nees ex steud) ev. Krishna. Acta Ecologica Sinica*, 42(4): 269-273.

Awadalla, S. S, El-Serfi, H.A.K, El-Hariry A. A and Wahsh, A. M. (2020). Influence of different cucumber varieties on the occurrence of the Piercing- sucking insect pests in Fayoum Governorate. *Journal of Plant Protection and Pathology*, 11 (11): 559-561.

Bakshi, P., Blushan, A., Bali, K., and Kour, K. (2019). Intercropping in fruit orchad: G way foreward for doubling the farmer's income. *International Journal of Agricultural Science,* 11(23): 9274-9276.

Gontijo, L.M., Beers, E. H. and Snyder, W. E. (2015). Complementary suppression of aphids by predators and parasitoids. *Biological Control*, 90:83-91.

Hatt, S. and Doring, F. T. (2025). The Interplay of intercropping, wildlife strips and weeds in conservation biological control and productivity. *Journal of Pest Science*, 98: 159-174.

Hatt, S. and Doring, T. F. (2023). Designing pest suppressive agroecosystems: principles for an integrative diversification science. *Journal of Clean Production,* 432: 139701.

Huang, C., Liu, Q., Li, X. and Zhang, C. (2019). Effect of intercropping on maize grain yield and yield components. *Journal of Integrative Agriculture*, 18(8): 1690-1700.

Jaharlal, S., Chakraborty, K. and Chatterjee, T. (2016). Biology of cotton aphid, *Aphis gossypii* Glover. *Journal of Global Bioscience*, 5(8):4467-4473.

Li, C., Hoffland, E., kuyper, T.W., Yu, Y., Zhang, C., Li, H., Zhang, F. and Van der Werf, W. (2020). Syndromes of production intercropping impact yield grains. *Natural Plants*, 6(6): 653- 660.

Martin-Guay, M. O., Paquette, A., Dupras, J., Rivest, D. (2018). The new green revolution; Sustainable intensification of agriculture by intercropping. *Science of the Total Environment*, 615:769-772.

Mondal, B., Mondal, C. K. and Mondal, P. (2020). *Stresses of Cucurbits; Current status and Management*. Singapore; Springer Nature Pte Ltd, PP 47-105.

Odewole, A. F., Adebayo, T. A., Olaniran O. A., Akanbi, W. B. and Onifade, O. O. (2018). Preliminary study of insect pests of cucumber (*Cucumis sativus L.*) in Ogbomoso Agricultural Zone of Nigeria. *Acta Fytotechnica et Zootechnica*, 21(3): 108 – 112.

Oliveira, S.G., bonfim, F. P.G., Alves, L.F., Marques, I. B., and Arauju, E. O. (2018). *Alelopatia de capim – adreira na germinacao, Vigor de sementese no desenvolvimento imicial do tomatecereja. Cad. Ciene. Agrar*, 10(1):7-12.

Pitan, O. O. R. and Filani, C. O. (2014). Effect of intercropping cucumber, *Cucumis sativus* (Cucurbitaceae) at different times with maize *Zea mays* (Poaceae) on the density of cucumber insect pests. *International Journal of Tropical Insect Science*, 34(4): 269-276.

Pongen, A. (2021). Diversity of Natural Enemy of insect pests of Cucumber (*Cucumis sativus)* on mid hills of Meghalaya. *Insect Environment,* 24(1): 53 – 57.

Raza, Q., Azhar, M. T., Rana, I. A., Ahmad, M. Q. and Atif, R. M. (2024). Biofortification of crops to achieve food and nutritional security. In biofortification of grain and vegetable crops (Pp. 1-17). Elservier; London.

Regan, K. H., Voortman, C. A., Wallace and Barbercheck, M. E. (2020). Prevalence of early-and late-season pest damage to corn in cover crop-based reduced-tillage organic systems. *Environmental Entomology*, 45: 85-65.

Saleem, S., Farooq, M. O., Razag, M., Hatt, S., Shah, F.M. (2025). Wheat intercropping with canola promotes biological control of aphids by enhancing enemy diversity. *Biological Control*, 200: 105677.

Shinde, G. S., Bhede, B.V., Rathod, V. U. 2021. Evaluation of different whorl applications for management of fall armyworm, *Spodoptera frugiperda* (J. E. smith) on maize. *Journal of Entomology and Zoology Studies*, 9(1), 394–398.

Shinde, P. B., Naik, K. V. and Golvankar, G. M., Shinde, B. D. and Jalgaonkar, V. N. (2018). Bioefficiency of insecticides against fruit flies infesting cucumber. *International Journal of Chemical Studies,* 6(15): 1681-1684.

Subr, Z., Predajna, L., Soltys, K., Bokor, B., Budis, J. and Glasa, M. (2020). Comparative transcriptome analysis of two cucumber cultivars with different sensitivity to cucumber mosaic virus infection. *Pathogens*. 9: 145.

Sudarma, I. M., Darmiati, N. N. and Suniti, N. W. (2023). Pest diversity in sweet corn [Zea mays saccharate (sturt) Bailey] in East Denpasar, Bali, Indonesia. *International Journal of Current Microbiology and Applied Sciences*, 12(6): 175-185.

Sun, Y., Clen, L., Zhang, S., Miao, Y., Zhang, Y., Li, Z., Zhao, J., Zhang, J., Qin, X., and Yao, Y. (2022). Plant interaction patterns. Shape of microbial community and nutrient cycling in different intercropping scenarios of aromatic plant species. Front *Microbiology.* 13: 888789.

Tajmiri, P., Fathi, S.A.A., Golizadeh, A. and Nouri-Ganbalani, G. (2017). Strip- intercropping canola with annual alfalfa improves biological control of *Plutella xylostella* (L.) and crop yield. *International Journal of Tropical Insect Science,* 37:208-216.

Ukatu, P. O., Asawalam, E. F. and Emeasor, K. C. (2025). Comparative efficacy of spacing on insect-pests of cucumber in cucumber-maize intercropping system. *African Journal of Agricultural Science and Food Research*, 19(1): 226-246.

Umeh, O. A. and Ojiako, F. O. (2018). Limitations of Cucumber (*Cucumis sativus L.*) Production for nutrition security in South East Nigeria. *International Journal of Agriculture and Rural Development*, 21(1):3437 – 3443.

Urge, M., Negeri, M. Demissie, G. and Selvaraji, T. (2020). Assessment of major field insect pests and their associated losses in maize crop production at West Hararghe Zone, Ethiopia. *Journal of Entomology and Zoology Studies*, 8(4): 2027-2037.

Yu, Y., Stomph, T.-J., Makowski, D., Wander Werf W. (2015). Temporal niche differentiation increases the land equivalent ratio of annual intercrops; a meta-analysis. *Field Crops Research,* 184:133-144.

Zarei, E., Faithi, S.A.S., Hassanpour, M., Ali, G. (2019). Assessment of intercropping tomatoe and sainfoin for the control of *Tuta absoluta*. *Crop Protection,* 120: 125-133

Table 1: Effect of cucumber-maize intercropping configuration on the population of *Epilachna chrysomelina* and *Aulacophora spp*

Treatment	*2023* *E. chrysomelina*	2024 *E. chrysomelina*	2023 *Aulacophora spp*	2024 *Aulacophora spp*
Va_1M_1	3.17±0.03^{c}	3.26±0.02^{cd}	4.50+0.07^{f}	5.45±0.09^{cde}
Va_2M_2	3.24±0.03^{c}	3.32±0.02^{c}	4.79±0.06^{ef}	5.65±0.06^{cd}
Va_3M_2	3.74±0.05^{b}	3.71±0.03^{b}	5.78±0.06^{bc}	6.09±0.10^{b}
Vm_1M_1	3.22±0.05^{c}	3.10±0.04^{cd}	4.48±0.09^{f}	5.12±0.09^{ef}
Vm_2M_2	3.34±0.09^{c}	3.17±0.06^{cd}	4.50±0.10^{f}	5.31±0.14d^{ef}
Vm_3M_2	3.67±0.02^{b}	3.68±0.04^{b}	5.58±0.02^{bc}	6.21±0.08^{ab}
Vn_1M_1	3.11±0.05^{c}	3.06±0.04^{d}	4.76±0.22^{ef}	4.93±0.11^{f}
Vn_2M_2	3.28±0.07^{c}	3.18±0.08^{cd}	5.01±0.07^{de}	5.16±0.06^{ef}
Vn_3M_2	3.80±0.03^{b}	3.66±0.03^{b}	5.93±0.07^{b}	6.13±0.12^{b}
Vo_1M_1	3.11±0.03^{c}	3.08±0.06^{d}	4.40±0.08^{f}	5.09±0.10^{ef}
Vo_2M_2	3.15±0.03^{c}	3.13±0.03^{cd}	4.61±0.04^{ef}	5.08±0.07^{ef}
Vo_3M_2	3.65±0.05^{b}	3.67±0.04^{b}	5.37±0.03^{cd}	5.83±0.07^{bc}
Sole cucumber	4.24±0.13^{a}	4.20±0.05^{a}	6.61±0.15^{a}	6.59±0.04^{a}
SED	0.08	0.07	0.13	0.12
COV (%)	3.4	2.7	3.7	3.0

Means along a column with the same alphabet(s) as superscript are not significantly different at P>0.05

Keys

Va_1M_1: 1 row of Mona Lisa variety of cucumber: one row of maize
Va_2M_2: 2 rows of Mona Lisa variety of cucumber: 2 rows of maize
Va_3M_2: 3 rows of Mona Lisa variety of cucumber: 2 rows of maize
Vm_1M_1: 1 row of Murano variety of cucumber: 1 row of maize
Vm_2M_2: 2 rows of Murano variety of cucumber: 2 rows of maize
Vm_3M_2: 3 row of Murano variety of cucumber: 2 rows of maize
Vn_1M_1: 1 row of Nandini variety of cucumber: 1 row of maize
Vn_2M_2: 2 rows of Nandini variety of cucumber: 2 rows of maize
Vn_3M_2: 3 rows of Nandini variety of cucumber: 2 rows of maize
Vo_1M_1: 1 row of cucumber marketer variety of cucumber: 1 row of maize
Vo_2M_2: 2 rows of cucumber marketer variety of cucumber: 2 rows of maize
Vo_3M_2: 3 rows of cucumber marketer variety of cucumber: 2 rows of maize
Sole cucumber: Cucumber Monoculture
SED: Standard Error of Difference of Means
CV: Co-efficient of Variation.

Table 2: Effect of cucumber – maize intercropping configuration on Vine length and number of leaves/plants

Treatment	Vine length (cm) 2023	Vine length (cm) 2024	Number of leaves 2023	Number of Leaves 2024
Va_1M_1	187.41±3.13^{a}	185.75±3.41^{ab}	24.91±0.32^{ab}	25.38±0.55^{ab}
Va_2M_2	183.87±3.20^{a}	184.35±2.50^{ab}	24.41±0.86^{ab}	24.71±0.43^{ab}
Va_3M_2	161.21±2.47^{bc}	157.42±3.71^{c}	23.91±0.89^{ab}	23.13±0.62^{bc}
Vm_1M_1	190.71±1.07^{a}	186.52±2.68^{ab}	25.75±0.39^{ab}	25.46±0.60^{ab}
Vm_2M_2	190.58±1.73^{a}	184.46±4.02^{ab}	25.12±0.44^{ab}	25.17±0.59^{ab}
Vm_3M_2	156.60±4.00^{c}	150.92±5.17^{c}	23.13±0.65^{b}	21.21±0.38^{c}
Vn_1M_1	191.21±2.26^{a}	193.39±0.86^{a}	27.33±0.55^{a}	26.13±0.53^{a}
Vn_2M_2	191.60±48^{a}	142.28±1.50^{a}	25.91±1.14^{ab}	26.00±0.52^{a}
Vn_3M_2	151.50±4.97^{c}	147.38±2.84^{c}	23.29±1.07^{b}	21.13±0.61^{c}
Vo_1M_1	180.62±3.19^{a}	175.54±3.84^{b}	25.54±0.56^{ab}	24.92±0.29^{ab}
Vo_2M_2	176.75±3.61^{ab}	175.12±4.16^{b}	24.95±0.64^{ab}	24.62±0.61^{ab}
Vo_3M_2	148.50±2.80^{c}	143.38±2.60^{c}	23.16±0.50^{b}	20.92±0.28^{c}
Sole cucumber	123.83±3.16^{d}	119.96±1.48^{d}	18.25±1.03^{c}	14.54±0.79^{d}
SED	4.48	4.39	1.07	0.71
CV (%)	3.7	3.7	6.2	4.3

Means along a column with the same alphabet(s) as superscript are not significantly different at P>0.05.

Keys

Va_1M_1: 1 row of Mona Lisa variety of cucumber: one row of maize
Va_2M_2: 2 rows of Mona Lisa variety of cucumber: 2 rows of maize
Va_3M_2: 3 rows of Mona Lisa variety of cucumber: 2 rows of maize
Vm_1M_1: 1 row of Murano variety of cucumber: 1 row of maize
Vm_2M_2: 2 rows of Murano variety of cucumber: 2 rows of maize
Vm_3M_2: 3 row of Murano variety of cucumber: 2 rows of maize
Vn_1M_1: 1 row of Nandini variety of cucumber: 1 row of maize
Vn_2M_2: 2 rows of Nandini variety of cucumber: 2 rows of maize
Vn_3M_2: 3 rows of Nandini variety of cucumber: 2 rows of maize
Vo_1M_1: 1 row of cucumber marketer variety of cucumber: 1 row of maize
Vo_2M_2: 2 rows of cucumber marketer variety of cucumber: 2 rows of maize
Vo_3M_2: 3 rows of cucumber marketer variety of cucumber: 2 rows of maize
Sole cucumber: Cucumber Monoculture
SED: Standard Error of Difference of Means
COV: Co-efficient of Variation

Table 3: Effect of cucumber – maize intercropping configuration on the yield of cucumber fruit

Treatmen	Fruit Yield (t/ha) 2023	Fruit Yield (t/ha) 2024
Va_1M_1	$12.77\underline{+}0.24^{abcd}$	$12.62\underline{+}0.24^{bc}$
Va_2M_2	$12.56\underline{+}0.09^{abcd}$	$12.21\underline{+}0.19^{cd}$
Va_3M_2	$11.19\underline{+}0.49^{bcde}$	$11.03\underline{+}0.13^{ef}$
Vm_1M_1	$12.95\underline{+}0.05^{abcd}$	$12.11\underline{+}0.11^{cd}$
Vm_2M_2	$12.50\underline{+}0.30^{abcd}$	$11.77\underline{+}0.15^{cde}$
Vm_3M_2	$10.43\underline{+}0.52^{def}$	$10.69\underline{+}0.22^{ef}$
Vn_1M_1	$13.92\underline{+}0.47^{a}$	$13.60\underline{+}0.31^{b}$
Vn_2M_2	$13.27\underline{+}0.41^{ab}$	$13.46\underline{+}0.31^{b}$
Vn_3M_2	$11.06\underline{+}0.17^{bcde}$	$11.26\underline{+}0.21^{de}$
Vo_1M_1	$10.76\underline{+}0.28^{cde}$	$11.53\underline{+}0.05^{de}$
Vo_2M_2	$10.23\underline{+}0.14^{ef}$	$11.01\underline{+}0.29^{ef}$
Vo_3M_2	$8.09\underline{+}0.42^{f}$	$10.16\underline{+}0.07^{f}$
Sole cucumber	$14.32\underline{+}1.30^{a}$	$17.26\underline{+}0.34^{a}$
SED	0.66	0.30
COV (%)	7.9	3.5

Means along a column with the same alphabet(s) as superscript are not significantly different at $P>0.05$

Keys

Va_1M_1: 1 row of Mona Lisa variety of cucumber: one row of maize
Va_2M_2: 2 rows of Mona Lisa variety of cucumber: 2 rows of maize
Va_3M_2: 3 rows of Mona Lisa variety of cucumber: 2 rows of maize
Vm_1M_1: 1 row of Murano variety of cucumber: 1 row of maiz
Vm_2M_2: 2 rows of Murano variety of cucumber: 2 rows of maize
Vm_3M_2: 3 row of Murano variety of cucumber: 2 rows of maize
Vn_1M_1: 1 row of Nandini variety of cucumber: 1 row of maize
Vn_2M_2: 2 rows of Nandini variety of cucumber: 2 rows of maize
Vn_3M_2: 3 rows of Nandini variety of cucumber: 2 rows of maize
Vo_1M_1: 1 row of cucumber marketer variety of cucumber: 1 row of maize
Vo_2M_2:2 rows of cucumber marketer variety of cucumber: 2 rows of maize
Vo_3M_2:3 rows of cucumber marketer variety of cucumber: 2 rows of maize
Sole cucumber: Cucumber Monoculture
SED: Standard Error of Difference of Means
CV: Co-efficient of Variation.