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Influence of Maize (*Zea mays*) and Cowpea (*Vigna ungulata*) Intercropping on Weed Growth and Maize Yield in Daloa, Côte d'Ivoire

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Abstract **Original Research Article**

This study aimed to evaluate the ability of different maize-cowpea intercropping systems to control weeds and increase maize grain yield. To achieve this objective, a trial involving 11 maize-cowpea intercropping systems was conducted at an experimental site of Jean Lorougnon Guédé University in Daloa, from April to June 2024. These were: maize sown in double rows in association with cowpea on the same day (T1) or 15 days after sowing of maize manual (T2), T1 + Application of mineral fertilizer (T3), T2 + Application of mineral fertilizer (T4), maize sown in single rows in association with cowpea on the same day (T5) or 15 days after sowing of maize (T6), T5 + Application of mineral fertilizer (T7), T6 + Application of mineral fertilizer (T8), maize sown in a pure crop, free of weeds with application of fertilizer (T9), maize sown in a pure crop, free of weeds without application of fertilizer (10) and maize sown in a pure crop without application of fertilizer or weeding (11). The experimental design was a Fisher block with three replicates. Results showed that intercropping maize in single rows with cowpeas sown on the same day or two weeks later, and the various maize-cowpea intercropping systems with mineral fertilizer application, provided better weed control. The best grain maize yields were also obtained with these treatments, with the exception of a control plot that remained weed-free throughout the growing cycle with mineral fertilizer application. These results suggest that, in order to improve maize yields in Daloa and ensure food security, intercropping maize in single rows with cowpeas should be prioritized.
Keywords: *Zea Mays*, *Vigna Ungulata*, Weed Management, Yield, Daloa, Côte d'Ivoire.
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1. INTRODUCTION

Daloa Department, in the Haut-Sassandra region, is a major food-producing area in Côte d'Ivoire (Douka, 2011). The main food crops grown in this area are rice, plantain, cassava, yam, and maize (Koffie-Bipko and Kra, 2013). Among these, maize is a crop with high nutrient requirements and is very susceptible to competition from weeds. In the past, to manage soil fertility and weed infestation in maize cultivation, as with other food crops in this area, shifting cultivation was practiced (De Foresta, 1995). This involves clearing forests and establishing crops for three or four years on the cleared plots before leaving them fallow for an extended period (Cuero, 2006). The long duration of fallow serves to restore soil fertility (Le Roy, 1995; Cuero, 2006).

Today, with the increasing scarcity of arable land in the Haut-Sassandra region (Gbakatchetche *et al.*, 2012; N'goran *et al.*, 2011), food crop producers are increasingly abandoning shifting cultivation and are widely adopting polycultures, often using a large number of inputs obtained through credit (Pierre, 2010). In addition to this new farming system, intercropping legumes with food crops and using legumes or legumes intercropped with cereals as a preceding crop can improve food production in the Haut-Sassandra region. Indeed, legumes can fix atmospheric nitrogen and improve soil fertility (Husson *et al.*, 2010). Furthermore, when used as cover crops, they can reduce weed growth (Husson *et al.*, 2010).

Mastering the conditions for intercropping maize with edible legumes can therefore ensure sustainable maize production in the Haut-Sassandra region. It is in this context that the present research project, entitled "Influence of Maize (*Zea mays*) and Cowpea (*Vigna ungulata*) Intercropping on Weed Infestation and Maize Yield in Daloa, Côte d'Ivoire," was initiated. The objective of the study is to evaluate the effect of intercropping maize (*Zea mays*) and cowpea (*Vigna ungulata*) on weed infestation and maize yield in order to contribute to the sustainable increase of maize production in the Haut-Sassandra region and ensure food security there.

2. MATERIAL AND METHODS

2.1. Study Area

This study was conducted at an experimental site of the Jean LOROUGNON GUEDE University in Daloa, in the Haut-Sassandra region, at 6°53°N latitude and 6°27°W longitude. The soils of Daloa are ferralitic (Koffié-Bikpo and Kra, 2013). This locality has a humid tropical climate, characterized by two seasons of unequal length, somewhat disrupted by current climate change (Koné *et al*., 2019). Typically, there is a rainy season from March to October and a dry season that begins in November and ends in February.

2.2. Treatments and Experimental Design

The experimental setup used in our study consisted of Fisher blocks. The total area of the experimental plot was 646 m² and that of the individual plots was 12.5 m² (5 m x 2.5 m). The distance between two adjacent blocks was 2 m and that between two contiguous individual plots within a block was 1 m.

Eleven (11) treatments were applied to the elementary plots during this study. These were:

- T1: Maize sown in double row in association with cowpea on the same day + manual weeding in the fourth week after sowing;
- T2: Maize sown in double row in association with cowpea with a two-week offset + manual weeding in the fourth week after sowing;
- T3: T1 + Application of mineral fertilizer;
- T4: T2+ Mineral fertilizer application;
- T5: Maize sown in single row in association with cowpea on the same day + manual weeding in the fourth week after sowing;
- T6: Maize sown in single row in association with cowpea with a two-week delay + manual weeding in the fourth week after sowing);
- T7: T5+ Mineral fertilizer application;
- T8: T6+ Mineral fertilizer application;
- T9: Maize sown in pure culture with the addition of fertilizer and herbicide;
- T10: Maize sown in pure culture without the addition of fertilizer and herbicide;
- T11 (control): Maize sown in pure culture without the addition of fertilizer or weed control.

Sowing was carried out in single and double rows (Akanza and N'Guessan, 2017). In single rows, the distance between two adjacent rows was 80 cm. Within a row, the distance between two adjacent maize plants was 20 cm. Cowpea rows were located between two maize rows at a distance of 40 cm from the maize row, and in each row, one seed was sown per hill at a distance of 20 cm, offset by 10 cm.

In double rows, the first two maize rows were 50 cm apart, with 25 cm between them. In the planting rows, one seed was sown per hill at a distance of 20 cm, and the distance between two adjacent rows was 50 cm. The second maize row was offset by 10 cm. The cowpea rows were equidistant from two adjacent maize rows, with 40 cm between them and 35 cm between cowpea rows. Three seeds were sown in hills 20 cm apart along each cowpea row.

To control insects during the study, an insecticide was applied to all individual plots from the first to the tenth week after sowing (Tapsoba *et al*., 2024). Maize plant thinning was carried out 15 days after sowing: this consisted of removing one plant out of every three, thus leaving two maize plants in each planting hole.

The agronomic parameters measured were the weed index and grain maize yield (Gabaze *et al*., 2022). These data were collected 90 days after sowing.

2.2.1. Weed Index

Weed indices are quantitative measures used in agriculture to assess the density, growth, competition, and effectiveness of weed control methods in a crop. These indices help farmers and agronomists make informed decisions about weed management. Several indices are commonly used, each offering a different perspective on weed dynamics. In this study, we use one: the weed index (WI).

The weed index (WI) measures the reduction in crop yield caused by the presence of weeds, compared to a weed-free plot (clean control). Its formula is:
WI (%) = ((Control yield - Treated plot yield) / (Control yield)) X 100.

A low damage index indicates better treatment effectiveness or low weed competition.

2.2.2. Maize Yields

To determine maize yield, a 1 m² section from the middle two rows of each plot was harvested in the end of the third month.
Y = P/S

Where P is maize grain quantity or production in kg, S , surface in ha, and Y, maize grain yield in kg/ha.

2.2.3. Statistical Analysis

In this study, the distribution parameters of the different samples were compared with each other using analysis of variance (ANOVA). ANOVA was used to compare the means of the calculated parameters of weed indices and maize yield. The significance level chosen for these analyzes is 5% (P = 0.05). The Duncan test was performed to compare the means two by two and assess the significant differences that exist between them. R was used to carry out this statistical test.

3. RESULTS

3.1. Weed Index

The weed indices for treatments T1, T2, T3, T4, T5, T6, T7, and T8 were 62.36, 63.85, 25.69, 22.2, 18.84, 18.05, 21.37, and 12.08, respectively. Analysis of variance showed a significant difference between these treatments for the weed index (P = 0.01). Duncan's test at the 0.05 significance level revealed two groups of treatments (figure 1). Treatments T1 and T2 had the highest weed index values, while T3, T4, T5, T6, T7, and T8 had the lowest values. This suggests that sowing maize in single rows intercropped with cowpea, followed by weeding four weeks after sowing, effectively controls weeds in maize crops. The same applies to treatments with single or double row maize sowing in association with cowpea with weeding in the fourth week after sowing and application of mineral fertilizer.

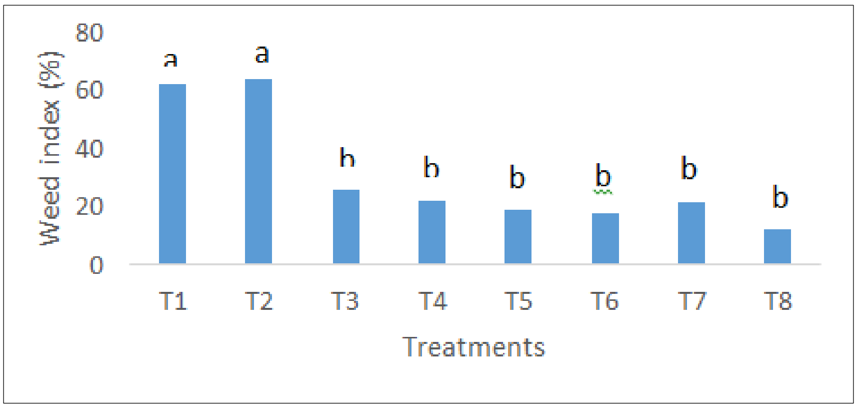

Figure 1 : Weed index according to maize-cowpea intercropping methods Treatments with the same letter are not significantly different.

3.2. Maize Yield

Maize grain yields for treatments T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, and T11 were 8773.33, 8413.33, 17333.33, 16400, 18880, 19002.66, 18586.66, 20850.66, 23333.33, 8000, and 4106.66, respectively. Analysis of variance revealed a significant difference in maize grain yield for these treatments (P = 0.01). Duncan's test at the 0.05 significance level revealed different treatment groups (figure 2). Treatment T9 yielded the highest grain maize yields, treatment T11, the lowest grain maize yields.

Among the different maize-cowpea intercropping methods, Treatment T8 showed the highest grain maize yield, while Treatments T1 and T2 showed the lowest grain maize yields. Treatment T8 was followed by Treatments T3, T4, T5, T6, and T7.

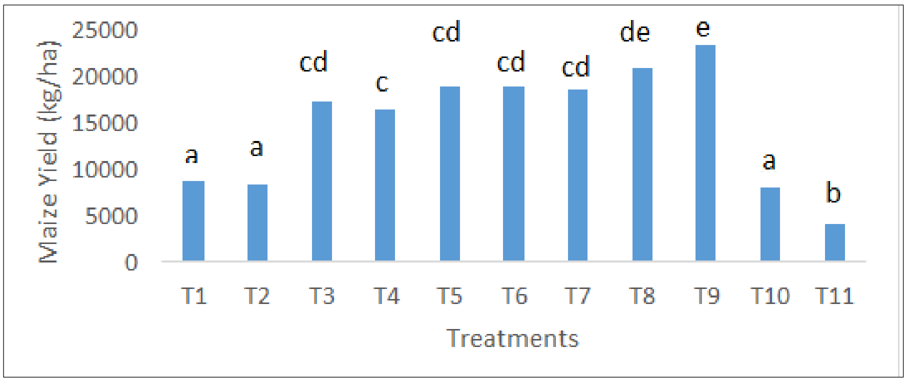

Figure 2: Maize grain yields according to applied treatments Treatments with the same letter are not significantly different

4. DISCUSSION

Sowing maize in single rows intercropped with cowpea, followed by weeding four weeks after sowing, effectively controlled weeds in maize crops. This means that cowpea, in this configuration, quickly covers the soil and prevents weeds from germinating and establishing on the soil surface. Indeed, a cover crop's ability to cover the soil and control weeds depends on its capacity to form a dense and rapid mat (Marin, 2017), blocking light and weed growth, improving soil fertility, and managing competition for water and nutrients.

Sowing maize in single or double rows intercropped with cowpeas, followed by weeding four weeks after sowing and the application of mineral fertilizer, also proved effective in controlling weeds in maize crops. The mineral fertilizer application allowed the cowpeas to grow rapidly and spread across the soil surface, preventing weeds from establishing in the maize field.

In this study, maize yields were generally very high. The lowest yield was around 4000 kg/ha on the grassed plots. This result is due to the maize variety used in the experiment, FNV10, a high-yielding variety producing two ears per plant.

Regarding the maize-cowpea intercropping arrangements, the highest grain maize yields were obtained with treatments T3, T4, T5, T6, T7, and T8, and the lowest with T1 and T2. This result suggests that, unlike treatments T1 and T2, the maize planting arrangement in treatments T5 and T6 allows them to efficiently absorb atmospheric nitrogen captured by the cowpea. The higher yields obtained in plots T3, T4, T7, and T8 could be explained by the application of mineral fertilizer. The difference between the treatments without fertilizer and the other treatments is due to the presence of nitrogen in the base fertilizer applied (Ilunga *et al*., 2018). However, the continuous application of mineral fertilizer may be ineffective in the long term. Moreover, in rural areas in Ivory Coast in general and in the Department of Daloa in particular, few farmers can regularly afford mineral fertilizers, due to their high cost.

The cowpea-maize intercropping system and the cowpea-maize intercropping system with mineral fertilizer were less effective than the T9 treatment for maize grain yield. These results are similar to those of Daoud *et al*., (2018). These researchers noted that the cowpea/maize intercropping system with organic fertilizer application resulted in a lower maize yield than that of pure maize with organic fertilizer application. This can be explained by the fact that in the cereal/legume intercropping system, the legumes only cover a portion of the nitrogen required for cereal plant growth. The remaining nitrogen must be supplied by a supplementary application of mineral or organic fertilizer.

These results suggest that to increase the agronomic performance of maize on poor soil without mineral fertilizer, the cowpea/maize association should have a preceding legume crop or organic fertilizer should be applied to this association.

The grain maize yields in the unweeded plots (treatment T11) were the lowest in this study. This could be explained by the fact that maize is very sensitive to weeds. Indeed, the presence of weeds in crop plots during the critical period of weed infestation significantly affects their agronomic parameters (Ruyet, 2006). In maize, this period corresponds to the stage when the plant has two to eight leaves.

5. CONCLUSION

This study evaluated the ability of 11 maize-cowpea intercropping systems to control weeds and increase maize grain yield in Daloa. These were: maize sown in double rows in association with cowpea on the same day (T1) or 15 days after sowing of maize manual (T2), T1 + Application of mineral fertilizer (T3), T2 + Application of mineral fertilizer (T4), maize sown in single rows in association with cowpea on the same day (T5) or 15 days after sowing of maize (T6), T5 + Application of mineral fertilizer (T7), T6 + Application of mineral fertilizer (T8), maize sown in a pure crop, free of weeds with application of fertilizer (T9), maize sown in a pure crop, free of weeds without application of fertilizer (10) and maize sown in a pure crop without application of fertilizer or weeding (11). The results showed that intercropping maize in single rows with cowpeas sown on the same day or two weeks later, and the various maize-cowpea intercropping systems with mineral fertilizer application, provided better weed control. The best grain maize yields were also obtained with these treatments, with the exception of a control plot that remained weed-free throughout the growing cycle with mineral fertilizer application. The results suggest that, in order to improve maize yields in Daloa and ensure food security, intercropping maize in single rows with cowpeas should be prioritized.

REFERENCES

- Akanza, P. K., & N'Guessan, E. N. D. (2017). Agronomic and economic performance of maize (zea mays l.) - peanut (arachis hypogaea l.) intercropping systems in northern Ivory Coast. Life, *Earth and Agronomy Sciences*, 5(1).
- Cuero, M. J. (2006). Maintaining the yield of Upland Rice Under Intensified Land Use in Slash and Burn Systems of West Africa. Mémoire de Master de Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS), University of Bonn, Germany, 59 p.
- Daoud, B. M., Traore, H. & Palé, P. (2018). Effets du système de culture et de la fertilisation organique sur l'infestation de Striga hermonthica et des rendements du maïs et du niébé dans la région du Chari-Baguirmi au Tchad. *International Journal of Biological and Chemical Sciences,* 12(3) : 1260-1273
- De Foresta, H. (1995). Cropping systems, invasive weeds and soil fertility: the case of *Chromoleana odorata*. Proceedings of the seminar on Soil Fertility and peasant strategies in the humid tropics, 13-17 November 1995, Montpellier, France, pp 236-244 4.
- Douka, A. M. (2011). The contribution of cooperatives to the regulation of food markets in Abidjan: the example of Camagoa Roxy. In: Food

security and food production in Côte d'Ivoire. L'Harmattan, Paris (France), pp 93 – 108.

- Gabaze, G. A. A., Mohamed, D., Malanno, K., Diakaria, C. N., & Lassina, F. (2022). Efficacy of a biopesticide based on *Cymbopogon winteranus* (lemongrass) extract in tomato (*Solanum lycopersicum* L.) cultivation in Central Côte d'Ivoire. *International Journal of Innovation and Applied Studies*, 36(3), 832-841.
- Gbakatchetche, H., Sanogo, S., Camara, M.; Bouet, A., Kéli, J. & Tahouo O. (2012). Mulching with pigeon peas to improve the yield of upland rice in Côte d'Ivoire. In: CNRA in 2011. CNRA, Abidjan (Côte d'Ivoire), p 12.
- Husson, O., Charpentier, H., Razanamparany, C., Moussa, N., Michellon, R., Naudin, K., Razafintsalama, H., Rakotoarinivo, C., Rakotondramanana, N., Enjalric, F. & Seguy, L. (2010). Maize or sorghum associated with a climbing food legume (cowpea, cowpea or umbellata). In Practical Manual of Direct Seeding in Madagascar. Volume III. 20p.
- Ilunga, T. H., Banza, M. J., Lukusa, M. L., Mukunto, K. I., Malonga, H. L., Kanyenga, L. A. & Nyembo, K. L. (2018). Influence of NPK application timing on the growth and yield of maize (*Zea mays* L.) established on a ferralsol. *Journal of Applied Biosciences*, 127: 12794-12803.
- Koffié-Bikpo, C. Y. & Kra K. S. (2013). The Haut-Sassandra region in the distribution of agricultural food products in Côte d'Ivoire. *Review of Tropical Geography and Environment*, 2: 95–103.
- Kone, K.H.C., Coulibaly, K. & Konan, K.S. (2019). Identification of some plants used in ethnoveterinary medicine in Sinématiali (Northern Ivory Coast). *Journal of Applied Biosciences*, 135: 13766-13774.13.
- Le Roy, X. (1995). Urban rice and field rice. In: Proceedings of the International Meetings on the Future of Rice Farming in West Africa, April 4-7, 1995, Bordeaux, France, pp. 157-169.6.
- Marin, Y. (2017). Use of cover crops to control weeds. Final Year Project, ISARA-Lyon, France, 55 p.
- N'Goran, K. E., Kassin, K. E., Zohouri, G. P., N'gbesso, M. F. D. P. & YORO G. R. (2011). Agronomic performance of yam-food legume intercropping in central-western Côte d'Ivoire. *Journal of Applied Biosciences* 43: 2915–29238. Pierre, 2010
- Pierre, D.B. (2010). Analysis of the functioning of mixed crop and livestock farms through the implementation of a support approach for producers. Master's thesis: Tropical Agronomy. Montpellier: Montpellier SupAgro, 216p.
- Ruyet F. (2006). The critical period of weed control and the effect of weeds on the morphology of grain maize (Zea mays L.) in Quebec. Master's thesis, Faculty of Graduate Studies of Laval University, Quebec, Canada, 84 p.
- Tapsoba, F. W., Ouedraogo, I., Hema, O. S. A., Ouattara, D. & Sanon, A. (2024). Evaluation of the efficacy of an insect growth regulator (Lufenuron 50 g/l) in the protection of maize against the fall armyworm (Spodoptera frugiperda JE Smith) in Burkina Faso: Running title: Efficacy of an insect growth regulator against the fall armyworm in Burkina Faso. *Natural and Applied Sciences*, 43(1), 216-238.