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Control Strategies Against the Infestation of *Striga Hermonthica* (Del.) Benth. In Millet [*Pennisetum Glaucum* (L.) R. Br.] Using Existing Cultural Management Practices in Farmers' Fields in Northern Côte D'ivoire

Condé Mariame

UFR of Biological Sciences / Department of Plant Biology / Peleforo University GON COULIBALY, Korhogo, Côte d'Ivoire (BP 1328 Korhogo / www.univ-pgc.edu.ci)

Siéné Laopé Ambroise Casimir

UFR of Biological Sciences / Department of Plant Biology / Peleforo University GON COULIBALY, Korhogo, Côte d'Ivoire (BP 1328 Korhogo / www.univ-pgc.edu.ci)

Kanfany Ghislain

Département de Productions Végétales et Agronomie, UFR des Sciences Agronomiques, de l'Aquaculture et des Technologies Alimentaires (S2ATA), Université Gaston Berger, B.P. 234, Saint Louis, Sénégal)

Kangbe Nintoh Esther

UFR of Biological Sciences / Department of Plant Biology / Peleforo University GON COULIBALY, Korhogo, Côte d'Ivoire (BP 1328 Korhogo / www.univ-pgc.edu.ci)

N'Guettia Tâh Valentin Félix

UFR of Biological Sciences / Department of Plant Biology / Peleforo University GON COULIBALY, Korhogo, Côte d'Ivoire (BP 1328 Korhogo / www.univ-pgc.edu.ci)

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Abstract: *Striga hermonthica* remains one of the main constraints to pearl millet production in Côte D'ivoire. The aim of the study was to identify the most effective modes and periods of application of local products such as compost and *Parkia biglobosa* fruit powder against its infestation. Thus, a study was carried out using a susceptible pearl millet variety to *Striga hermonthica*. The experimental design was randomized complete block design with 16 treatments in three replications. Principal component analysis (PCA) and ascending hierarchical classification (AHC) revealed four groups of treatments. The first group, comprising four treatments (T1, T2, T3 and T4), was characterized by good development and a high number of *Striga hermonthica* plants per plot (36.01 cm in height and 36.86 plants). Group 2, comprising three treatments (T8, T9 and T13), was characterized by late emergence (65.96 days after sowing) and a low number of *Striga hermonthica* plants per plot (15.92 plants). Group 3 was made up of six treatments (T0, T5, T6, T11, T12 and T14) which showed no particular effect on the variables studied. Group 4, comprising three treatments (T7, T10 and T15), was characterized by good millet ear characteristics (12.80 g per 1 ear and 7.27 g grain weight per ear). Thus, the treatments in groups 2 and 4 proved to be more effective in managing *Striga hermonthica* infestation in millet.

Keywords: Compost, control methods, pearl millet, Parkia biglobosa, *Striga hermonthica.*

Introduction: Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is the most widely grown cereal grass in semi-arid regions of Africa and Asia [1]. It is the main component in traditional cropping systems and remains the staple cereal in the diets of populations in areas where it plays a crucial role in food security [2]. In Côte d'Ivoire, cereals are staple crops, essential for food security [3]. Annual millet production is estimated at 67.000 tonnes per year [4]. For a requirement of 120.000 tonnes [5]. All production is consumed locally [6]. It ranks third among cereals produced and consumed in the country, after rice and maize [7]. Therapeutic virtues are attributed to its laxative, anti-malarial and anti-hemorrhoidal properties [8]. From a cultural, economic and social point of view, pearl millet occupies an important place among the populations of northern Côte d'Ivoire. It is a staple food in all northern ceremonies, especially funerals [9]. However, pearl millet yields are still very low, at around 500 kg/ha [7]. These low yields are essentially due to biotic and abiotic constraints that hinder the development of cereal crops. These include the proliferation of the parasitic weed *Striga hermonthica*, a major biotic constraint to cereal production. It causes significant crop losses of up to 100% of grain yield [10]. [11] estimates pearl millet yield losses due to Striga at between 1 and 30%, depending on the degree of infestation of plots. It therefore hampers pearl millet production and represents a threat to food security in infested areas. Faced with the threat posed by this weed, several control methods (mechanical, physical, chemical, cultural and biological using microorganisms) have been tested without success [12].

Each method used in isolation has its advantages, but also its shortcomings and limitations, particularly in view of the impoverishment of growers. Faced with this situation, new control strategies based on local products, easily accessible to growers, at lower cost and respectful of the environment, could provide an alternative solution for managing *Striga hermonthica* infestation in millet cultivation in northern Côte d'Ivoire. It is within this framework that this study was initiated with the aim of identifying the most effective methods and periods of application of local products such as compost and *Parkia biglobosa* fruit powder against *Striga hermonthica* infestation.

MATERIALS AND METHODS

Study site

The study was conducted on the experimental site of the Peleforo GON COULIBALY University of Korhogo, located near the botanical gardens (Figure 1). This reserve is located at -5, 63489 West longitude and 9, 43366 North latitude. Tests were conducted out under cover during the 2022 off-season. The climate in this area in sudanese, with a short rainy season and a long dry season. Rainfall is 1200 mm per year with very high interannual variability. Average annual temperature hovers around 27 °C. Soils are essentially ferruginous and ferralitic [13].

Plant material

The *Striga hermonthica* seeds used in this study were collected from *Striga hermonthica* plants parasitizing a pearl millet field in Diawala (Ouangolodougou Department) in October 2021. The seeds were cleaned of dust and capsule debris and stored in plastic bags at room temperature (approx. 30 °C). An improved, susceptible millet variety (SOSAT C88) was used as a host crop for *Striga hermonthica* [14].

Experimental design

The experimental set-up was 16 treatments randomized complete block design, with three replications. Each experimental unit was represented by three pots of 10 liters of 30 cm diameter and 28 cm deep with perforated bottoms. Each block consisted of 16 experimental units corresponding to the different treatments. These treatments were : T0 (control plot), T1 (53 g/pot of *Parkia biglobosa* fruit powder ploughed in at sowing, T2 (53 g/pot of *Parkia biglobosa* fruit powder ploughed in at weeding, T3 (35.33 g/pot of *Parkia biglobosa* fruit powder ploughed in at sowing, T4 (35.33 g/pot, of *Parkia biglobosa* fruit powder ploughed in at sowing, T5 (17.66 g/pot, of *Parkia biglobosa* fruit powder ploughed in at sowing, T6 (17.66 g/pot, of *Parkia biglobosa* fruit powder ploughed in at sowing [15], T7 (application of one gram (1g) of *Parkia biglobosa* fruit powder to the poquet at sowing [16], T8 (coating wet millet seeds with *Parkia biglobosa* fruit powder at sowing), T9 (spreading *Parkia biglobosa* fruit powder on the surface after emergence of *Striga hermonthica*), T10 (bokashi in pot (30 g/pot) at sowing, T11 (bokashi (35.325 g/pot) buried at sowing [17], T12 (T10+T8), T13 (T10+T7), T14 (T11+T8) and T15 : T11+T7.

Trial conduct

Before applying the treatments in the pots, each pot was filled ¾ full with soil taken from the surface horizon (0-30 cm) in a plot on the experimental site. It was treated with Capsidor 3GR (Fipronil) and then covered with black plastic sheeting, for one week, to control soil microorganisms. Each pot was artificially infested with 5 g of *Striga hermonthica* seeds in the first 5 cm of depth and watered regularly for two weeks. Pearl millet grain was sown 14 days after pre-conditioning. Pearl millet plants were thinned to one plant per pot 14 days after emergence.

Measurements and observations

For *Striga hermonthica*, measurements and observations focused on the emergence time of *Striga hermonthica* seedlings, which corresponds to the time elapsed between sowing and the date of appearance of the first *Striga hermonthica* seedling in an elementary plot, expressed in days after sowing; the dry biomass of a *Striga hermonthica* seedling, which was determined from 10 seedlings taken from each elementary plot at harvest. These plants were harvested, dried and then weighed using a precision balance, until a constant dry weight was obtained ; and the evolutionary dynamics of *Striga hermonthica* plants, which consisted of weekly counting of the number of *Striga hermonthica* plants from the first emerged *Striga hermonthica* plant to harvest per elementary plot.

For pearl millet, measurements were taken on the characteristics of pearl millet panicle harvested. Measurements were taken on panicle length (cm), panicle diameter (mm), panicle and grain weight (g).

Physico-chemical analysis of soil samples from the experimental site, compost and *Parkia biglobosa* fruit powder

Soil and compost samples were analyzed using the standard mckeague method [18], at the plant and soil laboratory (LAVESO) of the Ecole Supérieure d'Agronomie (ESA) in Yamoussoukro (Côte d'Ivoire):

for soil samples, the following elements were analyzed: pH water, pH Kcl, organic C (%), organic M (%), total N (%), P (mg/kg), available K (mg/kg), assimilable phosphorus, sand (%), clay (%), silt (%) and electrical conductivity (µs/cm). Soil analyses were carried out before and after the experiment, using 100 g of soil sample ;
for compost, the following elements were analyzed from 100 g of sample: organic matter (% OM), total carbon (% C), total nitrogen (% N), total phosphorus (% P2O5), total potassium (% K2O) and pH.

Chemical analyses of mineral salts (calcium, phosphorus, magnesium potassium, sodium, manganese, zinc, copper, iron, iodine and selenium) were carried out using the AOAC method (2010), while the Sofowora method (1996) was used for phytochemical analyses to test the presence of phytochemical constituents (polyphenols, flavonoids, tannins) from 5 g of déré powder sample.

Data analysis

The data collected were subjected to various statistical analyses. They were subjected to an analysis of variance to study the differences between treatments. Then, a principal component analysis (PCA) was used to highlight the features discriminating the treatments. Then, hierarchical ascending clustering (HAC) was performed to elucidate existing relationships between treatments. All these analyses were performed using R software version 4.3.1.

RESULTS

Results of physicochemical analysis of soil samples from the experimental site

The results of the analysis of soil samples taken at the start of the experiment showed that the soil on the study plot is sandy (84.43%), with an average content higher than that of silt (11.56) and clay (4.00%). The soil at this site had low average contents of organic matter (0.67), organic carbon (0.39) and nitrogen (0.05), as well as a low C/N ratio, equal to 7.8. However, it had higher average levels of assimilable phosphorus (81.33) and potassium (53.06). Its average electrical conductivity was 0.19 µS, and its hydrogen water potential (pHwater) 5.87 (Table 1).

The results of the soil analysis at the end of the experiment are shown in Table 2. The pH was generally acidic for all treatments, with a mean value ranging from 5.1 for treatment T4, which represents the lowest pH value, to the highest mean value of 6.4 for treatment T5. The percentage of nitrogen in the soil was very low, with mean values ranging from 0.03 (lowest value) for treatments T0, T12 and T13 to 0.08 (highest value) for treatments T4 and T8. In general, exchangeable bases (calcium, magnesium and potassium ions) were present in small quantities in the soil. Average calcium ion levels were 0.644 cmol+/kg for treatment T11, the lowest level, and 1.009 cmol+/kg for treatment T0, the highest level. Magnesium ion availability was highest in treatment T0 (0.443 cmol+/kg) and lowest in treatment T14 (0.266 cmol+/kg). Potassium ion availability was highest for treatment T1, at 0.312 cmol+/kg, and lowest for treatment T8, at 0.055 cmol+/kg. On the other hand, assimilable phosphorus was available in large quantities in the soil for all treatments, with a significant increase for treatment T15 (224 ppm). The lowest value was found in treatment T13 (23 ppm).

Results of physicochemical analysis of "Bokashi" compost samples

High level of nitrogen (0.50% m.s.), carbon (4.61% m.s.) and organic matter (7.90% m.s.) was noted on the Bokashi. The C/N ratio of the compost was average at 9.22. The respective contents of phosphorus (0.09% m.s), total potassium (0.88% m.s), calcium (0.90% m.s) and magnesium (0.30% m.s) were obtained (Table 3).

Results of physicochemical analysis of *Parkia biglobosa* fruit powder samples

The results of the physicochemical analysis of *Parkia biglobosa* fruit powder showed its richness in phenolic compounds and mineral salts. The values for phenolic compounds, namely polyphenols, tannins and flavonoids, were 285.33 mg/100g, 49.43 mg/100g and 15.59 mg/100g respectively (Table 4).

In terms of mineral salts, macroelements are present in greater quantities than microelements (Table 5). The macroelements, namely calcium (86.21 mg/100g), phosphorus (90.45 mg/100g), magnesium (66.39 mg/100g) and potassium (100.36 mg/100g), had higher levels than sodium (4.77 mg/100g). Microelements included manganese (0.55 mg/100g), zinc (0.09 mg/100g), copper (0.02 mg/100g), iron (0.29 mg/100g), iodine (0.012 mg/100g) and selenium (0.004 mg/100g).

Effect of treatments on emergence time of *Striga hermonthica* plants

Figure 2 shows the results of the statistical analysis of *Striga hermonthica* seedling emergence time. The results show a significant difference between the different treatments studied ($P<0.05$). Treatment T8 (millet seeds coated with *Parkia biglobosa* fruit powder) delayed the emergence of *Striga hermonthica* plants in the treated plots. The average duration of seedling emergence was 70 days after sowing. On the other hand, *Striga hermonthica* seedlings emerged early in plots receiving 53g/pot and 35.33 g/pot of

Parkia biglobosa fruit powder buried during dethatching (treatments T2 and T4). Average emergence times were 59 and 58 days after sowing respectively.

Effect of treatments on dry biomass per Striga hermonthica plant

The results of the statistical analysis of dry biomass per plant are shown in figure 3. Significant differences were observed between treatments (P<0.05). Treatment T3 (35.33g/pot of *Parkia biglobosa* fruit powder ploughed in at sowing) produced an average dry biomass value 2.31g higher. On the other hand, treatments T10 (30 g/pot of bokashi, at sowing), T12 (T10+T8) and T15 (T11+T7) obtained the lowest dry biomass values. These values were 0.75 g, 0.67 g and 0.68 g respectively.

Effect of treatments on Striga plant growth dynamics

Table 6 shows the evolutionary dynamics of the number of *Striga hermonthica* plants after emergence. The results of the statistical analysis show a significant difference between the different treatments for all dates (P<0.05). At 61 days after sowing (jas), treatment T15 (bokashi buried under the surface 35.325 g/pot + application of *Parkia biglobosa* fruit powder by pinch to poquet, at sowing) favored the emergence of a greater number of *Striga hermonthica* plants in the treated plots (14.22 plants). On the other hand, at the same date, no *Striga hermonthica* seedlings emerged in treatment T8 (coating wet millet seeds with *Parkia biglobosa* fruit powder at sowing). At 68 days, treatments T15 and T1 (53g/pot of *Parkia biglobosa* fruit powder buried at sowing) favoured the emergence of 24 and 24.89 *Striga hermonthica* plants respectively. However, treatments T8 and T9 resulted in the appearance of 1.89 and 1.56 *Striga hermonthica* plants respectively. From the 75th das to harvest (at the 103th das), treatment T3 (35.33 g/pot, of *Parkia biglobosa* fruit powder buried at sowing) favoured the appearance of the greatest number of *Striga hermonthica* plants. This number increased until it became constant at harvest at the 103th das (38.11; 64.89; 68.11; 67.78 and 67.78 plants). On the other hand, spreading *Parkia biglobosa* fruit powder on the surface after the emergence of *Striga hermonthica* plants (treatment T9) led to their death. This led to a reduction in the number of *Striga hermonthica* plants at 75 das, 82 das and 89 das respectively (9.78; 19.89 and 29.44 plants). At the end of the millet growing cycle, at the 96th and 103th das, a lower number of *Striga hermonthica* plants was recorded in treatment T15 (26, 67 plants and 18.89 plants).

Treatment effects on millet ear characteristics

The results of the statistical analysis of ear characteristics showed a significant difference between the different treatments (P<0.05). Plants treated with T7 produced the longest ears (25.75 cm). On the other hand, plants treated with T15 produced the shortest ears (9.82 cm). The largest ears (12.95 mm) were harvested from plots treated with T7, while the smallest ears (5.43 mm) were produced by plants treated with T5. In terms of ear dry weight, treatment T7 produced the highest value at 18.27 g. The smallest ears with a weight of 4.97 g were obtained in plots treated with T5 (17.66 g/pot, of *Parkia biglobosa* fruit powder buried at sowing). As for grain dry weight, the highest value was obtained with treatment T10 (7.87 g), while the lowest values were obtained with treatments T9 and T12 (2.66 g) (table 7).

Structuring the characteristics of the various treatments studied

To structure and group, the treatments, the CAH (Classification Hiérarchique Ascendante) approach was used on the data from the principal component analysis. This classification using the fourteen (14) variables produced four (4) main groups. The multiple analysis of variance showed a significant difference between these groups, whose characteristics are presented in Table 8. Group 1 consisted of four (4) treatments (T1, T2, T3 and T4) characterized by the greatest Striga plant heights at flowering and harvest (19.83 cm and 36.01 cm), the highest branching numbers at flowering and harvest (2.24 and 4.8), the highest biomass of a Striga plant (1.76 g) and the highest number of Striga plants at flowering (36.86 plants). Group 2, comprising three (3) treatments (T8, T9 and T13), was characterized by late emergence of *Striga hermonthica* plants and a smaller number of

Striga hermonthica plants. Group 3, comprising 6 (six) treatments (T0, T5, T6, T11, T12 and T14), was an intermediate group with no specific characteristics. Group four (4) comprised three (3) treatments (T7, T10 and T15). It showed the best values for ear characteristics: ear length (17.61 cm), ear diameter (10.50 mm), ear dry weight (12.81 g) and grain dry weight (7.27 g).

DISCUSSION

The appearance of *Striga hermonthica* plants was delayed in plots with millet plants grown from seeds coated with *Parkia biglobosa* fruit powder (T8) compared with plants in control plots. On the other hand, the plots that received 53 g/pot (T2) and 35.33 g/pot (T4) of *Parkia biglobosa* fruit powder buried in the soil at the time of weeding resulted in the early appearance of *Striga hermonthica* plants compared with *Striga hermonthica* plants in the control plots.This could be explained by the fact that the roots of the millet plants did not release stimulants likely to induce germination of *Striga hermonthica* seeds present in the soil [19].

This result suggests that coating millet seeds with *Parkia biglobosa* fruit powder has intrinsic properties for retarding the germination, growth and development of *Striga hermonthica* grains. In fact, the results of the analysis of *Parkia biglobosa* fruit powder samples showed the presence of phenolic compounds such as polyphenols, flavonoids and tannins, which are secondary defense metabolites. These elements would have prevented the host's roots from releasing stimulants that could induce germination of *Striga hermonthica* seeds in the soil. In contrast, the control plants do not have sufficient mineral elements. This result is in agreement with that of Olivier [19], who states that germination of *Striga hermonthica* seeds only occurs when the host roots secrete a substance called strigol around 4 mm from the *Striga hermonthica* seeds.

Observation of the dry biomass results showed that the application of 35.33 g/pot of *Parkia biglobosa* fruit powder ploughed in at sowing (T3) produced the highest dry biomass (2.31g). Although *Striga hermonthica* has green leaves, it is not fully photosynthetically functional [20]. It therefore takes the solutes required for growth from its host [21]. Thus, the increase in dry biomass for this treatment could be explained by the richness of the *Parkia biglobosa* fruit powder in mineral salts that can be directly assimilated by the plant. This would have provided *Striga hermonthica* plants with a large quantity of carbohydrates synthesized by the host plant for its own growth and development, in contrast to treatments T10, T12 and T15, which were less rich in mineral salts and obtained the lowest biomass respectively.

Concerning the evolutionary dynamics of *Striga hermonthica* plants, at flowering, the application of *Parkia biglobosa* fruit powder to the surface after emergence of *Striga hermonthica* (T9) resulted in the lowest population density of *Striga hermonthica* (19.89 plants/pot). The reduction in population density following the application of *Parkia biglobosa* fruit powder to the surface after emergence of *Striga hermonthica* suggests that *Parkia biglobosa* fruit powder has herbicidal properties that reduce the number of *Striga hermonthica* plants after emergence in the plots. In fact, its application led to the death of *Striga hermonthica* plants emerging in the pots, giving it a phytotoxic role. According to [15], *Parkia biglobosa* fruit powder contains an active ingredient that affects the physiological and morphological development of Striga grains, which can be degraded by biotic and abiotic factors.

The values for millet ear characteristics were influenced by the treatments. In fact, the application of *Parkia biglobosa* fruit powder by pinch at sowing (T7) enabled the millet plants to produce long, large and heavy ears. The results of the physico-chemical analysis of the *Parkia biglobosa* fruit powder showed that it contains mineral salts such as phosphorus and potassium, which are necessary for good plant development. In addition, according to [22], the technique of localized application of fertilizer by the packet (microdoses) is particularly promising in terms of the efficiency of fertilizer use by the plant. The high values of dry weight of grains per ear obtained with the application of 30 g of bokashi to the sowing spot (T10) would result from the availability of mineral elements for the millet plants and the density of *Striga hermonthica* plants, which was lower during flowering. The results of compost analysis showed high levels of nitrogen (0.50%), organic matter (7.90%) and organic carbon (4.61%). [23], assert that organic matter is an important source of nutrients for plants.

CONCLUSION

This study has enabled us to distinguish two groups of treatments of interest in the management of *Striga hermonthica* infestation in millet crops. These are the group of treatments (T8, T9 and T13) corresponding respectively to the coating of millet seeds with *Parkia biglobosa* fruit powder, the spreading of *Parkia biglobosa* fruit powder after Striga emergence, and the application of *Parkia biglobosa* fruit powder and compost to the pocket. It was characterized by late emergence of *Striga hermonthica* plants and a reduced number of *Striga hermonthica* plants at millet flowering. And the group formed by treatments (T7, T10 and T15) corresponding respectively to the application of one gram of *Parkia biglobosa* fruit powder per pinch, to the application of compost to the millet and to the combination of *Parkia biglobosa* fruit powder to the millet and compost on the surface. He presented the best characteristics of millet ears. Group 2 is the treatment group par excellence for controlling Striga hermonthica infestation, as it not only delays the emergence of *Striga hermonthica*, but also reduces their numbers. To better determine the efficacy of these different treatments, further tests will be necessary in the farming environment, in order to promote them to growers in infested crop zones in Côte d'Ivoire.

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AUTHORS'CONTRIBUTIONS

Condé Mariame participated in drafting the experimental protocol, setting up the experimental set-up, collecting data, analyzing data, interpreting results and writing the document. Siéné Laopé Ambroise Casimir corrected the experimental protocol, took part in setting up the experimental set-up, analyzing the data and reading the document. Kanfany Ghislain and N'Guettia Tâh Valentin Félix helped set up the experimental set-up and analyze the data. Kangbe Nintoh Esther participated in setting up the experimental set-up and collecting data.

CONFLICTS OF INTEREST

The authors have declared no conflicts of interest.

REFERENCES

Segnou, J.; Akoa, A.; Youmbi, E. and Njoya, J. Effect of mineral and organic fertilization on fruit yield of chilli pepper (*Capsicum annuum* L. solanaceae) in lowland forest zone of Cameroon. 2012, 10.

Gowda, C. L. L. ; Rai, K. N. Evolution of hybrid parents' research. In : Hybrid parents research at ICRISAT. 2006, ICRISAT, Center Patancheru, 1-10.

Sangaré, A.; Koffi, E.; Akamou, F.; Fall, C. A. National Report on the State of Plant Genetic Resources for Food and Agriculture. 2009, Ministry of Agriculture, Côte d'Ivoire, 65.

Faostat. www.fao.org/faostat/fr/#home. 2021 (Accessed 05/24/2023)

Faostat. http://www.fao.org/faostat/fr/#data/QC. 2018 (Accessed 06/19/2021)

Béninga, M. B.; Dadié, A. Evaluation of millet grain losses due to insects. 2015, *European Scientific Journal,* 11 (21) : 266-275. ISSN : 1857 - 7881 (Print) e - ISSN 1857- 743. https://eujournal.org/index.php/esj/article/view/6000/5783.

Beninga, M. B. Genetics, improvement and extension of millet (*Pennisetum glaucum* (L.) R. Br.) in Côte d'Ivoire. 2007, Thèse de Doctorat d'Etat, UFR Biosciences, Université de Cocody, Abidjan, Côte d'Ivoire, 179.

Amané, N. D.; Assidjo, N. E.; Gbongue, M. A.; Bohoussou, K. ; Cardot, P. Physicochemical characterization of a traditional West African beer: tchapalo. 2005, *Agronomie Africaine* 17(2) : 143-152.

Siéné, L. A. C.; Condé, M.; Nguettia, T. V. F.; Kouadio, A. F. B. and Bayala, R. Characterization of cultivation systems based on millet (*Pennisetum glaucum* (L.) R. Br.) in the savannah district of northern Côte d'Ivoire. 2024, *Int. J. Biol. Chem. Sci*. 18(4): 1343-1365. DOI https://dx.doi.org/10.4314/ijbcs.v18i4.11

Atera, E. A.; Itoh, K.; Azuma, T. & Ishii, T. Farmers' perspectives on the biotic constraint of *Striga hermonthica* and its control in western Kenya. 2012, *Weed Biology and Management*, 12 : 53-62.

Beninga, M. B. Diagnosis of millet (*Pennisetum glaucum* (L.) R. Br.) -based cropping systems in Côte d'Ivoire and prospects for improvement. 2014, *Journal of Biosciences*, 79 : 6878-6886. http://dx.doi.org/10.4314/jab.v79i1.3

Boussim, I.; Yonli, D.; Guinko, S. & Salle, G. Infestation status, endogenous knowledge and systematic approach to species of the genus Striga in Burkina Faso. 2011, *Int. J. Biol. Chem. Sci.* 5(4) : 1374-1386. DOI : http://dx.doi.org/10.4314/ijbcs.v5i4.4

Koné, M. Study of woody cover variability in savannah environnments using high-resolution satellite imagery : the case of northern Côte d'Ivoire. 2004, Doctoral thesis, University Felix Houphouet Boigny, cocody, Abidjan, Côte d'Ivoire, 135p.

RECA. Improved millet varieties in Niger : HKP dominates the certified seed markEt. 2020, 5 p.

Kambou, G.; Ouedraogo, O.; Some, N. & Ouedraogo, S. Effects of Parkia biglobosa pod powder on *Striga hermonthica* emergence, Soil biological activity and maize yield. 1999, *Science et technique, Sciences naturelles* ; 23 (2) : 60-70.

Lado, A.; Sani, F. U.; Yahaya, S. U.; Karaye, A. K. Efficacy of Parkia biglobosa fruit powder on the control of Striga in cowpea cropping systems in the Sudan Savanna Nigeria. 2018, *Heliyon*, 4, e00733. doi : 10.1016/j.heliyon

1. Yonli, D. Integrated control of *Striga hermonthica* (Del.) Benth. Combining biological control based on Fusarium spp. with certain cultural practices in Burkina Faso. 2006, PhD thesis, University of Ouagadougou, U F R / Life and Earth Sciences, Speciality : Applied Biological Sciences, 192.

2. McKeague, J.; A. Manual of soil sampling and analysis methods.1978, Soc Can Sci Sol, 2nd ed. Ottawa, De impe, 114 – 233.

3. Olivier, A. Striga, a parasitic weed of African cereals : biology and control methods. 1995, *Agronomie*, 15 : 517-525

4. Wolfe, A. d. And Depamphilis C. w. The effect of relaxed functional constraints on the photosynthetic gene rbcL in photosynthetic and nonphotosynthetic parasitic plants. 1998, *Mol. Biol. Evol,* 15 (10) :1243-1258.

5. Issoufou, H. B. A. and Moussa, N. N. R. Multi-site evaluation of the effect of *Striga gesnerioides* (willd) vatke parasitism on functional traits of cowpea varieties. 2020, *Int. J. Adv. Res*, 8(12) : 639-649. Doi : http://dx.doi.org/10.21474/ijar01/12191

6. Buerkert, A. Effects of crop residues, phosphorus and spatial soil variability on yield and nutrient uptake of pearl millet (*Pennisetum glaucum* (L.) R. Br.) in southwest Niger. 1995, Thesis, Verlag Ulrich E. Grauer, Stuttgart, 272.

Koffie, B. and Yeo, L. Journal of Geography, Regional Planning and Development "Urban Market Gardening and Food Safety in Korhogo". 2016, 2.

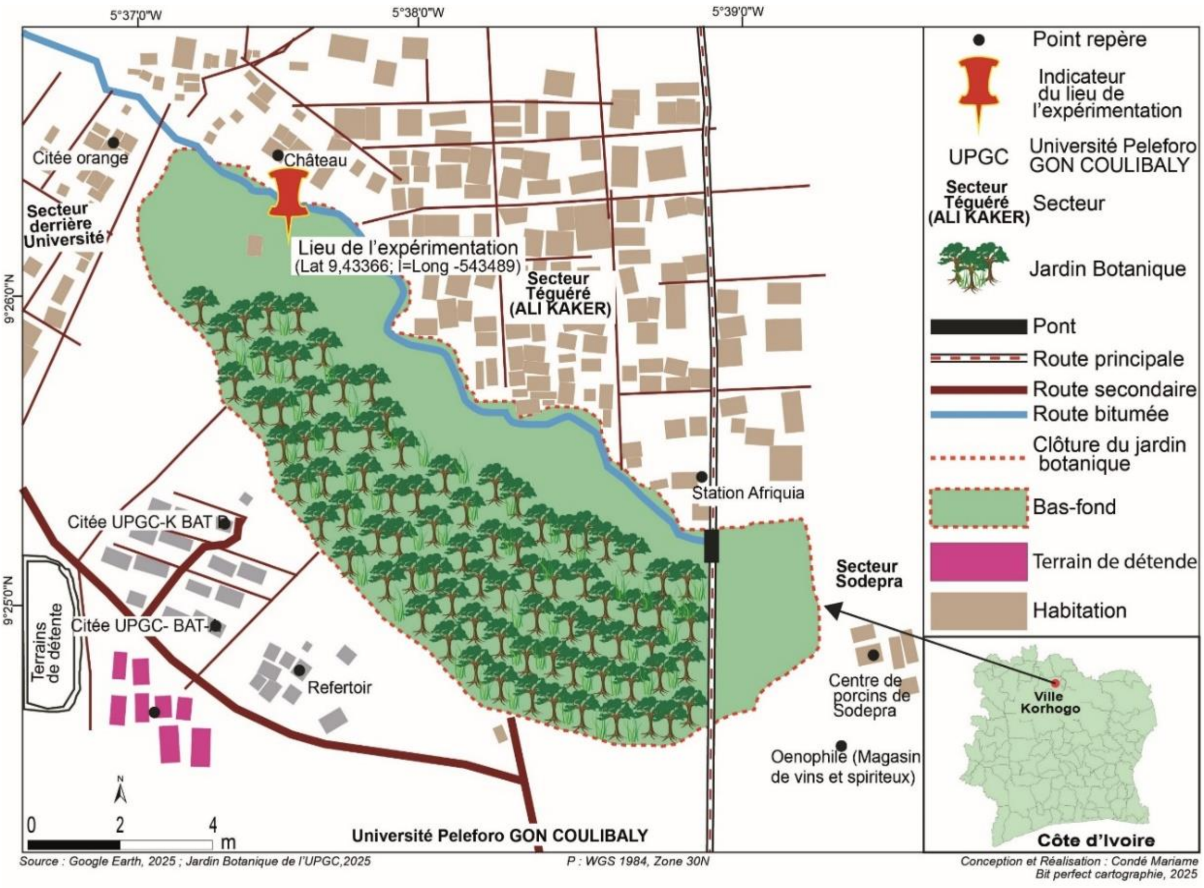

Figure 1 : Map of the study site

Table 1 : Physicochemical characteristics of soil samples before setting up the experiment

Clay (%)	Fine silt (%)	Coarse silt (%)	Fine sand (%)	Coarse sand (%)	PhH$_2$O	pHKcl	EC (µS)	Available phosphorus (ppm)	MO (%)	C (%)	N (%)	C/N	K (g/kg)
4.00	**3.50**	**8.06**	**29.25**	**55.18**	**5.87**	**3.90**	**0.19**	**81.33**	**0.67**	**0.39**	**0.05**	**7.8**	**58.06**

ph H2O : hydrogen potential of water; ph Kcl : hydrogen potential of potassium chloride; C-organic: organic carbon; C/N : carbon/nitrogen, N: total nitrogen; K available: available potassium; available phosphorus; CE: electrical conductivity; MO: organic matter (= C x 1.72).

Table 2 : Physicochemical characteristics of soil samples at the end of the experiment

Treatments	Ph	N (%)	P. assi (ppm)	Ca2+ (cmol +/kg)	Mg2+ (cmol +/kg)	K+ (cmol +/kg)
T0	5.7	**0.03**	56	**1,009**	**0.443**	0.108
T1	5.3	0.04	67	0.974	0.392	**0.312**
T2	5.2	0.07	74	0.935	0.377	0.100
T3	5.3	0.05	103	0.985	0.396	0.227
T4	**5.1**	**0.08**	56	0.959	0.386	0.246
T5	**6.4**	0.06	64	0.950	0.388	0.074
T6	5.5	0.05	39	0.959	0.388	0.178
T7	5.4	0.06	40	0.974	0.395	0.116

T8	6.2	**0.08**	69	0.954	0.391	**0.055**
T9	5.7	0.04	76	0.998	0.401	0.218
T10	5.4	0.06	57	0.893	0.367	0.123
T11	6.3	0.05	94	**0.644**	0.275	0.082
T12	5.3	0.03	64	0.955	0.387	0.187
T13	6.3	0.03	**23**	0.665	0.287	0.076
T14	6.3	0.07	61	0.656	**0.266**	0.069
T15	5.3	0.03	**224**	0.970	0.390	0.083

ph H_2O: hydrogen potential of water; N: total nitrogen p. assi : assimilable phosphorus; Ca: calcium; Mg: magnesium; K: potassium

Table 3 : Physicochemical characteristics of compost samples Bokashi

Magnesium (%)	Carbon (% ms)	Total nitrogen (% ms)	Calcium (% ms)	Total potassium (% ms)	Phosphorus (% ms)	Matter Organic (% ms)	C/N
0.30	**4.61**	**0.50**	**0.90**	**0.88**	**0.09**	**7.90**	**9.22**

Table 4 : Phenolic compound contained in *Parkia biglobosa* fruit powder

Phenolic compound	Polyphenols (mg/100g)	Tannins (mg /100g)	Flavonoids (mg /100g)
Values	**285.33**	**49.43**	**15.59**
Standard deviation	**1.36**	**0.88**	**0.34**

Table 5 : Mineral salts contained in *Parkia biglobosa* fruit powder

Calcium (mg/100)	Phosphorus (mg/100)	Magnesium (mg/100)	Potassium (mg/100)	Sodium (mg/100)	Manganese (mg/100)	Zinc (mg/100)	Copper (mg/100)	Iron (mg/100)	Iodine (µg/100)	Selenium (mg/100g)
86.21	90.45	66.39	100.36	4.77	0.55	0.09	0.02	0.29	0.012	0.004

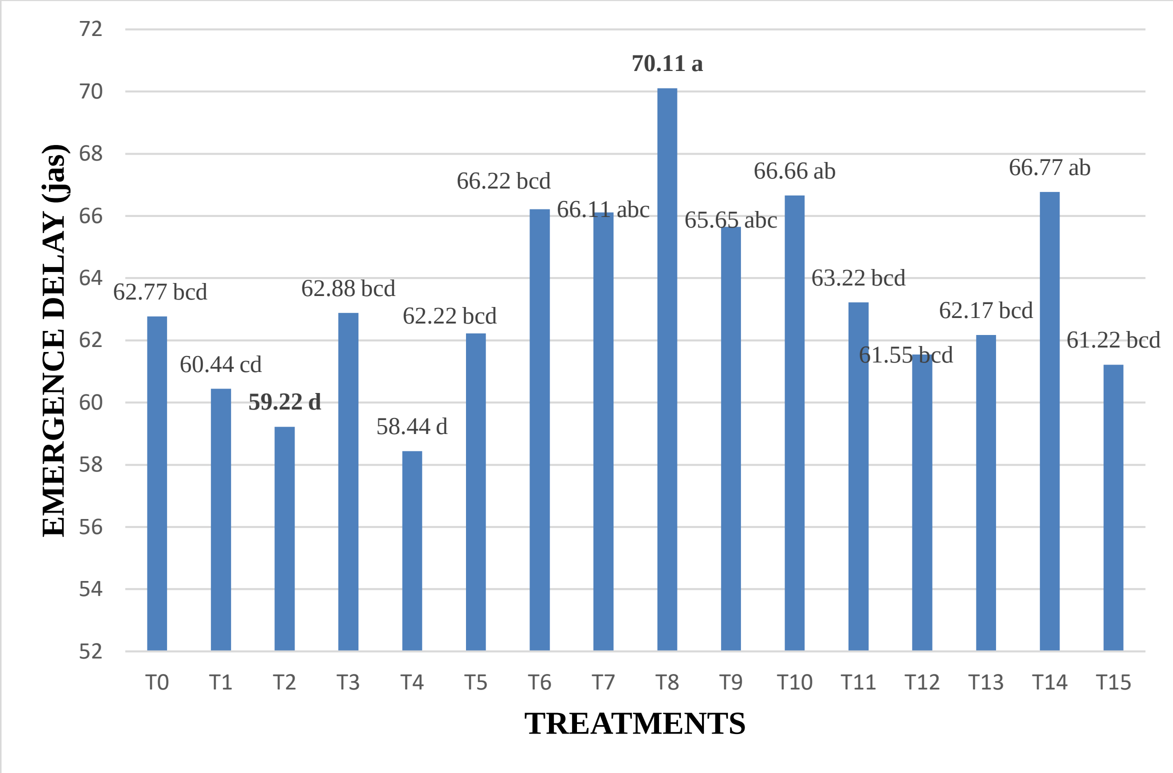

Figure 2 : Emergence time of *Striga plants hermonthica*

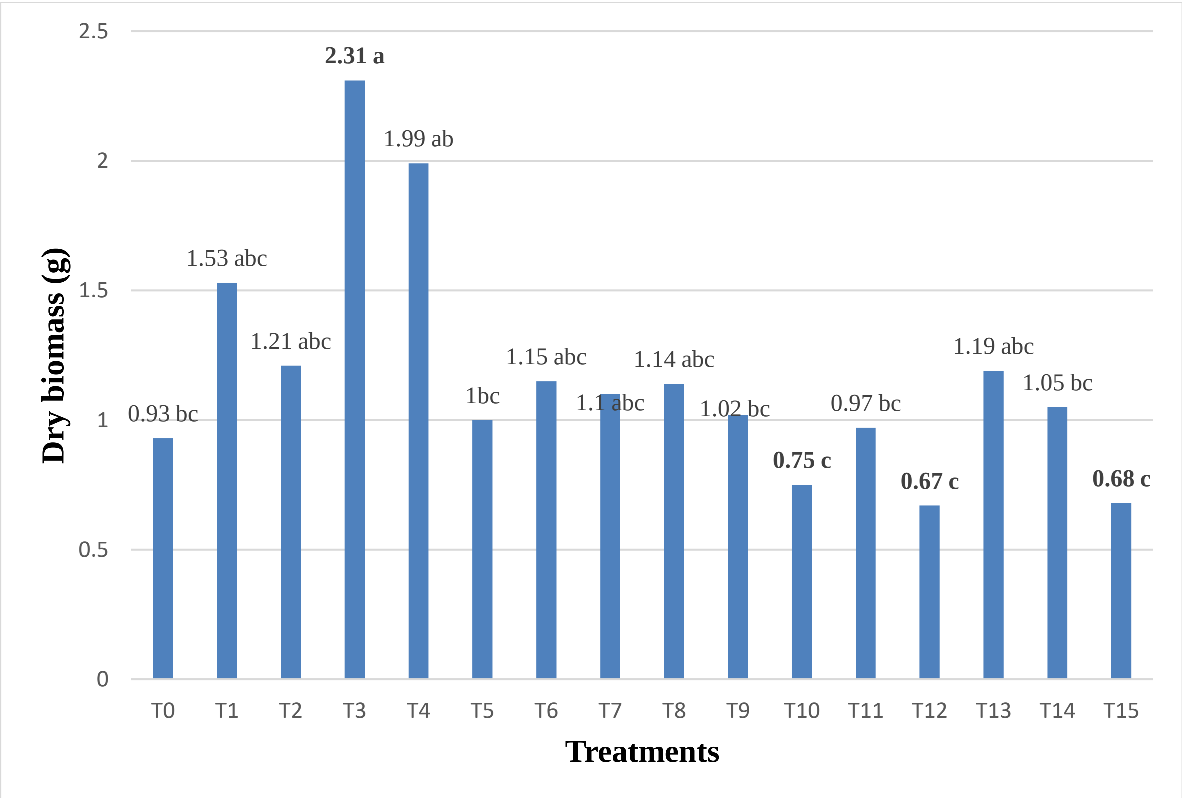

Figure 3 : Dry biomass of a *Striga* plant *hermonthica*

Table 6 : Evolutionary dynamics of *Striga plants hermonthica*

Treatments	61 JAS	68 JAS	75 JAS (Bloom)	82 JAS	89 JAS	96 JAS	103 JAS
T0	**2.11 b**	15.89 abcd	29.11ab	42.33 bcd	52.78 abcde	47.44 abcde	44.44 abcdef
T1	8.67 ab	**24.89 a**	**38.11 a**	49.78 abcd	65.33 ab	54.11abc	51.56 abcde
T2	8.22 ab	23.78 ab	**35.56 a**	53.56 ab	61.89 abc	49.22 abcde	47.44 abcde
T3	6.11 ab	21.56 abc	**38.11 a**	**64.89 a**	**68.11 a**	**67.78 a**	**67.78 a**
T4	**4.22 b**	22.11 abc	**35.67 a**	48.56 abcd	46.11abcde	36.11bcde	36.00 cdef
T5	**2.78 b**	17.56 abc	**35.11 a**	47.33 abcd	32.78 of	28.89 of	30.22 def
T6	**3.56 b**	16.56 abc	**35.67 a**	51.56 abc	54.33 abcd	58.56 ab	63.22 ab
T7	**0.44 b**	9.33 bcd	25.44 ab	36.44 bcde	42.67 bcde	37.00 bcde	37.44 bcdef
T8	**0.00 b**	**1.89 d**	19.78 ab	33.22 bcde	45.11 abcde	43.89 abcde	43.78 abcdef
T9	**0.67 b**	**1.56 d**	**9.78 b**	**19.89 e**	**29.44 e**	29.89 cde	32.11 cdef
T10	**0.44 b**	8.67 cd	**30.33 a**	31.11 cde	40.56 cde	**26.67 e**	27.11 ef
T11	**4.89 b**	14.11 abcd	**37.33 a**	43.33 abcd	47.22 abcde	52.00 abcd	54.78 abcd
T12	**5.33 b**	17.33 abc	29.56 ab	40.67 bcde	48.56 abcde	52.44 abcd	47.67 abcde
T13	**3.44 b**	9.00 cd	18.22 ab	29.11 of	39.56 cde	40.78 bcde	39.44 bcdef
T14	**2.11 b**	12.89 abcd	25.56 ab	41.89 bcd	59.78 abc	57.56 ab	57.22 abc
T15	**14.22 a**	**24.00 a**	**31.44 a**	43.67 abcd	38.78 cde	**26.67 e**	**18.89 f**

Table 7 : Characteristics of millet ears

Treatments	Spike length (cm)	Ear diameter (mm)	Dry weight of the cob (g)	Dry weight of grains 1 ear (g)
T0	17.16 abc	6.93 bcd	**5.05 b**	3.96 ab
T1	19.67 ab	8.45 abcd	10.37 ab	6.09 ab
T2	18.67 abc	6.33 cd	**6.32 b**	3.17 b
T3	16.89 abc	7.85 bcd	**6.69 b**	3.39 ab
T4	12.50 bc	8.77 abcd	**8.97 b**	5.41 ab
T5	17.05 abc	**5.43 d**	**4.97 b**	5.60 ab
T6	18.61 abc	8.91 abc	**10.18 b**	6.16 ab
T7	**25.75 a**	**12.95 a**	**18.27 a**	7.02 ab
T8	17.89 abc	7.02 bcd	**6.23 b**	4.86 ab
T9	20.60 ab	6.95 bcd	**7.36 b**	**2.66 b**
T10	17.25 abc	10.25 ab	11.41 ab	**7.87 a**
T11	16.78 abc	6.59 bcd	**9.88 b**	4.45 ab
T12	14.28 bc	6.39 cd	**5.68 b**	**2.66 b**
T13	17.50 abc	7.01 bcd	**7.16 b**	4.36 ab
T14	16.72 abc	9.26 abc	**9.77 b**	5.75 ab
T15	**9.82 c**	8.30 abcd	**8.74 b**	6.93 ab

Table 8 : Main characteristics of the different groups obtained from the hierarchical classification into principal components

Variables	Group 1 (4 treatments)	Group 2 (3 treatments)	Group 3 (6 treatments)	Group 4 (3 treatments)	Pr > F	Significance
Emergence delay	60.25 b	**65.96 a**	63.13 ab	**64.667 a**	0.060	Yes
Striga flowering time	28.88 a	31.33 a	30.35 a	29.265 a	0.152	Yes
Height at Flowering	**19.83 a**	6.45 c	12.76 b	10.701 b	0.000	Yes
Height at Harvest	**36.01 a**	26.79 bc	31.31 ab	24.202 b	0.027	Yes
Branching at Flowering	**2.24 a**	0.11 c	0.96 b	0.504 bc	0.000	Yes
Branching at harvest	**4.8 a**	3.35 cd	4.03 bc	3.245 b	0.039	Yes
Dry biomass 1 plant	**1.76 a**	1.12 b	0.96 b	0.845 b	0.003	Yes
Number of striga plants at flowering	**36.86 a**	**15.92 c**	32.05 ab	29.074 b	0.000	Yes
Rate of presence of symptoms	54.63 a	46.91 a	48.14 a	56,790 a	0.163	No
Mortality rate at Harvest	33.33 a	25.92 a	42.59 a	40,737 a	0.515	No
Length of ears	16.93 b	18.66 b	16.76 b	**17.607 b**	0.903	Yes
Diameter of ears	7.85 b	6.99 b	7.25 b	**10.500 a**	0.037	Yes
Dry weight of ears	8.08 b	6.91 b	7.58 b	**12.807 a**	0.077	Yes
Dry grain weight	4.51 b	3.96 b	4.76 b	**7.273 a**	0.027	Yes