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Effect of Organo Mineral Fertilization on Weed Infestation and Dynamic in Upland Rice Growth in The Southern Sudanian Zone of Burkina Faso

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HIGHLIGHTS

- Dynamism and specific diversity of weeds were determined;
- The impact of fertilisation on weed clustering was determined;
- The effect of weeds on upland rice yield was evaluated.

Abstract

Weeds are a major biotic constraint in rice production, causing crop yield losses. Fertilization system may be an effective control of weeds. This study aims to improve rice productivity through soil amendment and weed management in Burkina Faso. Method. The trial was set up in a Fisher block design with 4 replications and 10 fertilizer treatments. The effect of the fertilization was assessed on weeds at 45 days after planting through their abundance and dry biomass, and on rice through plant height and grain yield. weeds diversity at 65 days old has an average Shannon index of 2.9 bits. Three (03) weed clusters and their indicator species that are associated with the treatments studied were identified at 65 days after sowing. The Cyperus esculentus L. weed grouping was found to be associated with the organo-mineral fertilizer treatments. The application of poultry manure plus urea obtained simultaneously the lowest weed infestation rate (6.37 g/m^2) and the highest grain yield (1.6 t/ha). Thus, to improve the productivity of upland rice, integrated weed management could be a combination of poultry manure treatments combined with mineral fertilization and specific control methods for the main species of the *Cyperus esculentus* L. group.

Keys words: Poultry manure, weeds, indicator species, diversity, up-land rice

1. Introduction

Rice cultivation feeds more than 50% of the world's population. In terms of global production, rice is the second most important cereal after corn, with 755.1 million tons produced in 2016 (FAO, 2018). In recent years, demand for rice has grown strongly at 6% per year in West and Central Africa (Rio and Brent, 2014). In Burkina Faso, rice is the fourth most produced cereal (Bazié et al. 2014). Moreover, rice is increasingly consumed with an average annual consumption of 35 kg per person in 2013 and about 50 kg/person/year in large urban centers (FAO, 2014).

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There are three types of rice cultivation, namely upland, lowland and irrigated rice, with a national production of 384,690 tons (INSD, 2017). Up-land rice, represents 23% of the rice growing area and contributes 5% to national rice production. This type of rice cultivation is only suitable for regions of Burkina where annual rainfall reaches or exceeds 800 mm (Ouédraogo et al. 2011). This type of rice cultivation. Several improved varieties from varietal selection programs are available for this type of rice cultivation, mainly, FKR 45N, FKR 59 and FKR 61. Crop rotation between rice and other cereals is low and irregular (Traoré, 2015).

Indeed, weeds are the second most important limiting factor in rice production after water (Deuse et al. 1980). They limit rice productivity through competition for nutrients (Anonymous, 1995). These two factors are a specific constraint in upland rice production. Crop rotation systems that could improve soil fertility upland rice production are almost non-existent in (Traoré et al. 2015; Sanou et al. 2019). Thus, it is necessary to propose integrated fertilizer management methods in this cropping system

The effect of environmental and agronomic factors on weed dynamics is a prerequisite for any cropping system (Barralis and Chadoeuf, 1980). It is in this context that this article aims to determine the effect of organo-mineral fertilization on weed infestation and dynamics in up-land rice production in western Burkina Faso.

2. Materials and Methods

The study was conducted at the Farako-Bâ research station, headquarters of the DRREA-Ouest, within the INERA Rice and Rice Culture Program. The station is located about 10 km south of Bobo-Dioulasso on National Road No. 07 (Bobo - Banfora axis), in the Sudanian zone of Burkina Faso. Its geographical coordinates are: 11°6' North latitude, 04°20' West longitude and 405 m altitude. The amount of rainfall varied from 59.1 to 262 mm between 4 and 14 days during the 2016, 2017 wet seasons (Figure 1 and 2).

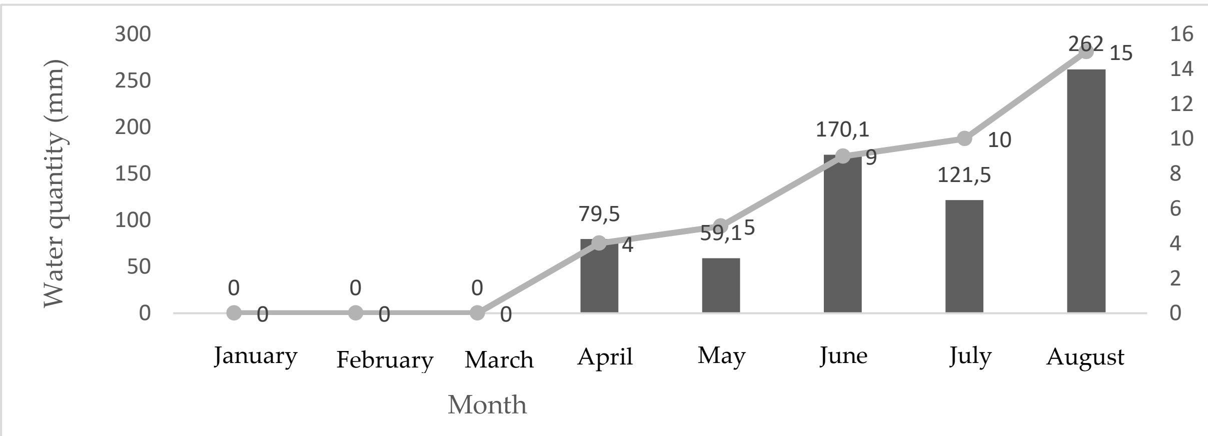

Figure 1: Rainfall of the Farako-Bâ station, 2016

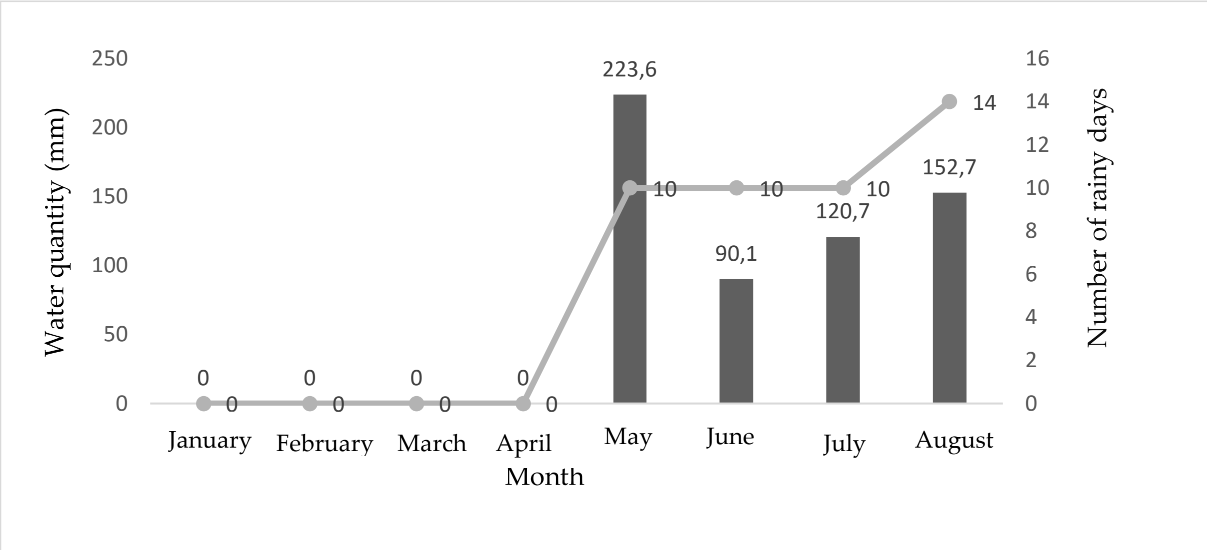

Figure 2: Rainfall at the Farako-Bâ station, 2017

The plant material used for the experiment is the rainfed rice variety FKR 59N with a sowing maturity cycle of 90 days from INERA. The fertilizers used were organic (poultry droppings, and compost and mineral (Burkina phosphate (BP, NPK). The organic matter was either rice straw harvested during the previous season or manure composed of animal dung produced at the Farako-Bâ.

The trial was conducted in a fully The Randomized Block Designing with 10 fertiliser treatments (Table 1) and 4 replications. The factor studied was the type of fertilisation at 10 levels (Table 1). The total trial area was 571.5 m2 and the individual plots were 9 m2 (3 m × 3 m) each. The unit plots were separated by 0.5 m rows and the blocks by 1 m rows. Ploughing was carried out by animal traction one week before sowing, followed by levelling and loosening of the soil to obtain a good seedbed. Various fertilisers such as poultry droppings as well as Burkina phosphate (BP) and compost were incorporated into the soil two (02) days before sowing. Sowing was carried out seven days after ploughing with a spacing of 20 cm between the rows and between bunches, followed by de-matting with two (02) plants per bunch at 14 days after sowing (DAS). The doses of fertilizers were applied in each elementary plot in accordance with the fertilization. NPK (14-23-14) was applied at sowing. Urea was applied in two fractions at 15 and 46 days after weeding. NPK (14-23-14) was applied at sowing (200 kg/ha). Urea was applied in two fractions at 15 (35 kg/ha) and 46 days after weeding (65 /ha).

Table 1: List of manures applied in the elementary plots

Treatments	Fertilization mode
F1	Absolute control (no manure)
F2	NPK (14 -23-14) + Urea
F3	Urea + BP (500 kg/ha)
F4	Poultry manure (7.5 t/ha)
F5	Poultry manure (7.5 t/ha) + Urea
F6	Poultry manure (7.5 t/ha) + BP (500 kg/ha)
F7	Poultry manure (7.5 t/ha) + BP (500 kg/ha) + Urea
F8	Rice straw compost (10 t/ha) + Urea extension
F9	Rice straw-based compost (10 t/ha) + BP (500 kg/ha)
F10	Rice straw-based compost (10 t/ha) + BP (500 kg/ha) + Urea

Data collection was done on weeds and rice crop:
- Weed biomass (g/m²): Weed biomass was determined after weeding at 45 days after harvesting in three 1 m² plots and drying for 24 hours at 60°C in the oven;
- Weed cover (%): was determined at 45 days after harvesting according to the Marnotte (1984) scale (Table 2);
- Weed abundance: was determined during the inventory at 65 DAS, using the Barralis (1976) scale (Table 2).
- Height (cm) of rice plants: This parameter was recorded on 12 plants along the diagonals within each elementary plot using a ruler;
- Number of rice tillers: This was counted on 12 plants along the diagonals in each
- diagonals of each elementary plot;

- Weight of 1000 grains: this was obtained by counting 1000 grains and weighing them with an electronic scale.

- Yield (t/ha): Harvests were made on the useful plots after removing the two border lines. Paddy yield was calculated and reported per hectare at 14% moisture content using the following formula: R (t/ha) = (14×10-2 ×R)/ (Th×Su) (R = Yield (t/ha) obtained from the useful plot; Th = Moisture content of harvested paddy; Su = Useful area).

Floristic surveys were used to characterize floristic richness/diversity in the plots:

(i) Shannon-Weaver index: The Shannon-Weaver (1949) index (H) is an indicator of diversity, taking into account not only species richness, but also the proportion of each species represented within the community. It varies between 1 and 5 (Lincy, 2003). The higher the Shannon index, the greater the diversity. This index can be used to determine the level of stand structure. Two stands may have the same diversity index but different taxonomic richness, and therefore different levels of structure.

The Shannon-Wiener index is calculated according to the following formula:

$\mathbf{Ish = -\Sigma \left(\frac{ni}{N}\right) \log_2 \left(\frac{ni}{N}\right)}$, where ni is the number of species i and N is the total number of species;

(ii) Simpson's index: Simpson's index (SI), which favors the most abundant species, expresses the probability that two (02) individuals chosen at random from an infinite population belong to the same species, and varies between 0 and 1. The higher the index, the lower the dominance within the group (Lincy, 2003).

Simpson's index is calculated according to the following formula:

$\mathbf{IS = \Sigma \left(\frac{ni}{N}\right)^2}$, where ni is the number of species i and N is the total number of species;

(iii) Piélou Equitability Index: The Piélou Equitability Index (Eq), measures the degree of diversity achieved by a stand in relation to its maximum value, and enables us to compare two groups that do not have the same number of species (Grall and Coïc, 2005).

It lies between 0 and 1. If Eq tends towards 0, then almost all individuals belong to a single species within the group, and when Eq takes the value 1, then all species have exactly the same coverage or importance within the group.

The Piélou Equitability Index was calculated using the following formula:

$\mathbf{Eq = \frac{ISh}{\log_2 N}}$, where N is the total number of species;

(iv) Weeds clustering and influence of treatments on clustering : Cluster analysis was used to determine weeds grouping. The influence of treatments on clustering was determined using the indirect Canonical Correspondance Analysis (CCA) method;

(v) Indicator species: The indicator species of the clusters were determined by Indicator Species Analysis (ISA), which uses a Monte Carlo test to give the following values: the indicator value of the species, the probability at the 5% threshold of the indicator species. The taxonomic names of the indicator species will be used to name the plant groupings (Dossou et al., 2012).

The Excel spreadsheet was used for data entry. Variance analysis was carried out using Genstat statistical analysis program, and comparisons of means were made using Duncan's test with a threshold of 5%.

PC-ORD version 5.0 ordination program was used to carry out the canonical correspondence analysis (CCA) and the phytosociological analysis of the weeds, making it possible to highlight the influence of treatments on weed distribution.

Table 2: Combined scale of Marnotte (1984) for scoring cover rate and Barralis(1976) and weed abundance

Class	P (%)	Recovery rate (%)	Abundance
1	< 1	Species present, but rare	< 1 individual/m2
2	1-7	Less than one individual per m2	1-2 individual /m²
3	7-15	At least one individual per m2	3-20 individual /m²
4	15-30	15-30% cover	21-50 individual /m²
5	30-50	30-50% cover	>50 individual m²
6	50-70	50-70% cover	
7	70-85	Strong cover	
8	85-93	Very little visible soil	
9	93-100	Full coverage	

3.Results and discussion

The weed flora recorded at 65 days before harvest on all the treatments is 20 species belonging to 20 genera and 08 families. The class of dicotyledons represents 70% and the dominant families are *Cyperaceae* (25%) and *Fabaceae* (25%) (figure 3). The canonical correspondence analysis (CCA) of the main matrix consisting of 20 species inventoried at 65 JAS, reveals that the two axes explain 26.9% of the existing relationship between species and treatments (Figure 4). The Monte Carlos test showed that the treatments had a significant effect on the distribution of 15% of the species on the first two axes (P<0.05%) with the formation of three weed plant groupings. The rate of weed cover at 45 days after planting varies according to the fertilization method (Table 3 and 4). The analysis of variance shows that there is a highly significant difference (P<0.001) between treatments in terms of plot coverage. The F1 treatment recorded the highest rate of coverage, i.e. 55%, compared to the F7 treatment, which recorded the lowest rate of coverage (27.5%). Weed dry biomass at 45 days after planting also varied among treatments (Table 4). Analysis of variance reveals that manures had a highly significant effect on weed dry biomass (P<0.001). Treatment F4 had the highest dry biomass (27.40g/m2). On the other hand the lowest was recorded with treatment F5 (6.37g/m2).

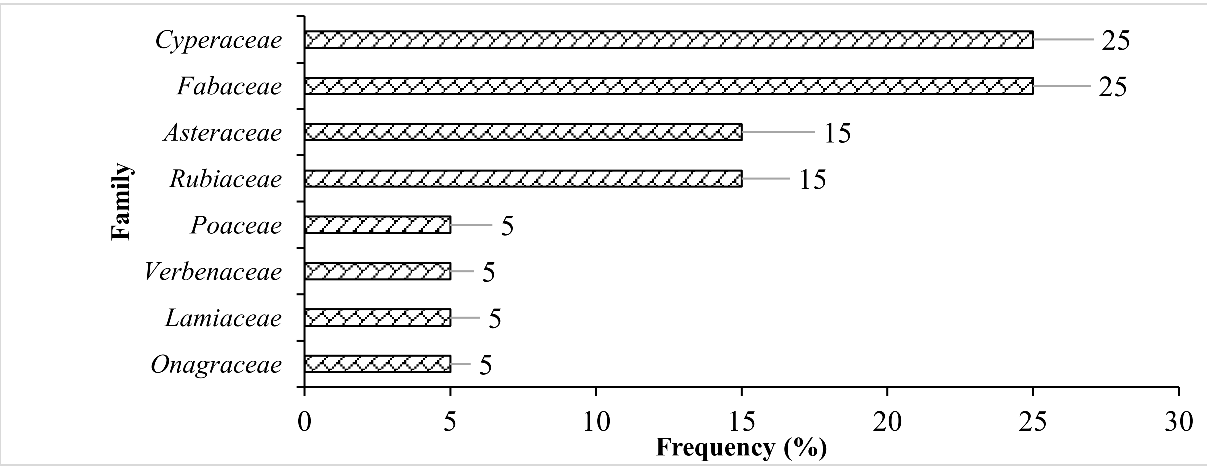

Figure 3: Frequency (%) of weed families inventoried at 65 DAS

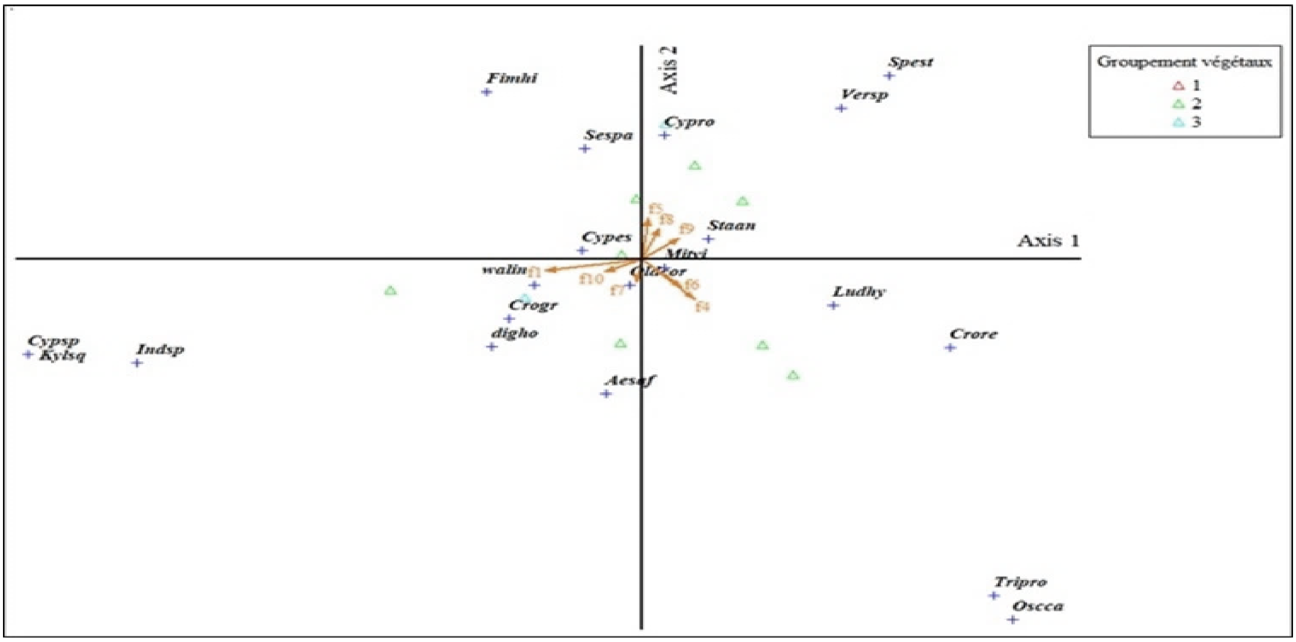

Figure 4: Distribution diagram of weed species inventoried at 65 DAS according to treatments.

Legend: Plant grouping: Grouping of weeds where the influence of the treatments is the most significant ; 1; 2, 3: Weed subgroups according to the influence of the most significant treatments

Table 3: Plant grouping characteristics of weed species inventoried at 65 DAS

Code	Name of the grouping	RS	Indicator species	IVI	P-value (Monté Carlo)	Dominant family	Ish	IS	IE
G1	*Sesbania pachycarpa* de Candolle	5	*Sesbania pachycarpa* de Candolle	60	0,0002	*Fabaceae*	2,9	0,93	0,96
G2	*Oldenlandia corymbosa* L.	13	*Oldenlandia corymbosa* L.	43,9	0,0344	*Cyperaceae* *Fabaceae*	2,9	0,93	0,95
G3	*Cyperus esculentus* L.	2	*Cyperus esculentus* L.	54,2	0,0016	*Cyperaceae*	2,9	0,93	0,96
			Moyenne				**2,9**	**0,93**	**0,956**

SR: Species richness; IVI: Species indicator value; H: Shannon index; SI: Simpson index; IE: Piélou equitability index

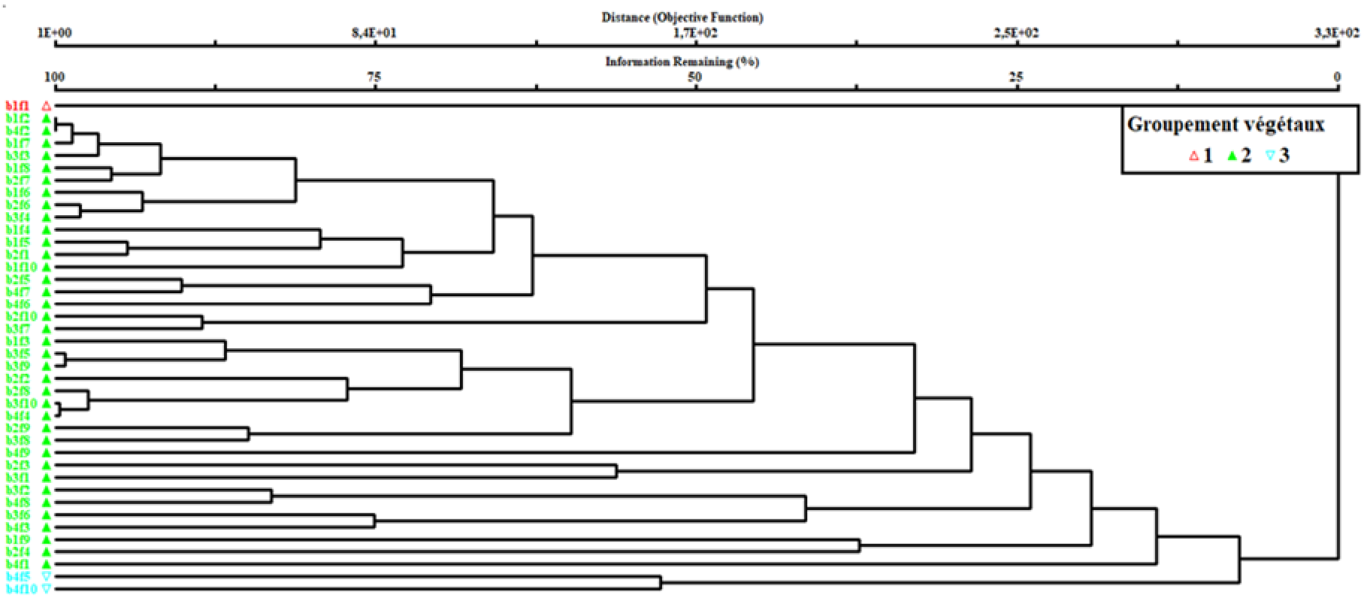

Figure 5: Classification dendrogram of weed species inventoried on the 65 DAS treatments at Farako-Bâ

Legend: Plant groupings. Weed groups where the influence of the treatments is most significant;1; 2, 3: Weed subgroups according to the influence of the most significant treatments.

Table 4: Coverage rate at 45 DAS of the plots and Dry biomass of weeds according to the fertilization mode, Farako-Bâ, wet season 2016 and 2017

Fertilization mode	Recovery rate (%) at 45 DAS	Dry biomass (g/m²)
F7 (Poultry manure + BP + Urea)	27,5ᵃ	7,75ᵃ
F8 (Compost + Urea)	35ᵃᵇ	9,12ᵃ
F3 (Urea + BP)	40ᵃᵇᶜ	10,02ᵃ
F5 (Poultry manure + Urea)	40ᵃᵇᶜ	6,37ᵃ
F10 (Compost + BP + Urea)	45ᵇᶜ	13,45ᵃᵇ
F2 (NPK + Urea)	45ᵇᶜ	8,60ᵃ
F4 (Poultry manure)	50ᵇᶜ	27,40ᶜ
F6 (Poultry manure + BP)	50ᵇᶜ	19,05ᵇ
F9 (Compost + BP)	50ᵇᶜ	26,67ᶜ
F1 (Control without manure)	55ᶜ	11,67ᵃ
P	0,009	<0,001
M	43,8	14,01
Cv (%)	9,5	16,6

3.1. Effect of treatments on yield parameters of rice

The number of tillers and the height of the rice plants varied according to the fertilization method at 45 days after planting (Table 5). For the number of tillers, there was a highly significant difference (P<0.001) between treatments. The F1 treatment (Control without fertilization) has the lowest average number of tillers (1.2 tillers). While treatment F5 (Poultry manure + Urea), recorded the highest average number of tillers (3.5 tillers). Treatments F10 (Compost + BP + Urea), F5 (Poultry manure + Urea) and F4 (Poultry manure) form a statistically homogeneous group.

The same tendency can be observed regarding the height of the plants. Indeed, the highest plant height (84.7 cm) was obtained with the F5 treatment (poultry manure) while the lowest (41.7 cm) was obtained with the F1 control treatment. Straw biomass and rice grain yield varied according to the fertilization method (Table

6). The results show a highly significant difference (P<0.001) between treatments for straw yield. Treatment F5 had the highest straw biomass (7.3 t/ha) while the T1 control had the lowest straw biomass (0.7 t/ha). Treatments F6, F4, F7 and F5 formed a statistically homogeneous group with treatment F5.

With respect to rice grain yield, the F1 control treatment had the lowest grain yield (0.3 t/ha). The highest grain yield was obtained with treatment F5 (1.6 t/ha), which forms a statistically homogeneous group with treatments F7 and F6.

Table 5 : Number of tillers and height (cm) of rice plants according to the fertilization method, Farako-Bâ, wet season 2016 and 2017

Fertilization mode	Number of tillers	Height (cm)
F1 (Control without fertilizer)	1,196^{a}	47,31^{ab}
F3 (Urea + BP)	1,870^{ab}	61,39^{c}
F9 (Compost + BP)	1,929^{b}	56,77^{abc}
F8 (Compost + Urea)	1,287^{ab}	44,82^{a}
F10 (Compost + BP + Urea)	3,331^{c}	81,47^{d}
F2 (NPK + Urea)	3,234^{c}	80,27^{d}
F5 (Poultry manure + Urea)	3,507^{c}	84,74^{d}
F4 (Poultry manure)	3,407^{c}	77,33^{d}
F7 (Poultry manure + BP + Urea)	1,817^{ab}	58,84^{bc}
F6 (Poultry manure + BP)	1,511^{ab}	51,97^{abc}
P	<0,001	<0,001
M	64,5	2,309
Cv (%)	9,0	15,8

Table 6: Straw biomass (kg/ha) and grain yield (t/ha) of rice according to mode, Farako-Bâ, wet season 2016 and 2017

Fertilization mode	Straw weight (t/ha)	Grain yield (t/ha)
F1 (Control without fertilizer)	0,7^{a}	0,3^{a}
F10 (Compost + BP + Urea)	1,1^{ab}	0,70^{ab}
F2 (NPK + Urea)	1,0^{b}	0,80^{ab}
F3 (Urea + BP)	0,8^{a}	0,40^{ab}
F4 (Poultry manure)	18,0^{c}	1,4^{c}
F5 (Poultry manure + Urea)	20,5^{c}	1,6^{c}
F6 (Poultry manure + BP)	1,73^{c}	1,5^{c}
F7 (Poultry manure + BP + Urea)	2,02^{c}	1,5^{c}
F8 (Compost + Urea)	11,0^{ab}	0,84^{b}
F9 (Compost + BP)	7,7^{a}	0,60^{ab}
P	<0,001	<0,001
M	1,36	0,98
Cv (%)	18,8	18,9

3.2. Discussion

At the end of the 65 DAS inventory, *Cyperaceae* (25%) and *Fabaceae* (25%) were identified as the most dominant families. In fact, a study of farmers' perceptions of the most harmful weed families revealed that the *Cyperaceae* is the most feared family in up-land rice production in Burkina Faso (Sanou, 2019). Regarding the distribution of classes where dicotyledons (70%) are the most frequent. Traoré and Maillet (1998) obtained a similar frequency for dicotyledons within cereal crops in Burkina Faso. Rahali et al. (2010) explain this dominance in part by the effect of tillage that is much less favorable to the development of monocotyledons. Three plant groupings were identified based on the effect of fertilisation at 65 JAS.

However, this influence is weak because fertilizer type and level explain only 26.9% of the grouping of weed species at 65 DAS. In lowland rice, the effect of fertilizer type and level on weed distribution is stronger, averaging 41% (Sanou et al. 2022). This could be explained by the fact that the lowland rice cropping system is a continuous rice cropping system. However, other factors not considered in this study contribute to the distribution of weeds in cultivated fields, namely crop growth and associated cropping practices (Freid et al. 2008).

In the present study, three (03) species were considered as characteristic species because of their strong indicator value within the plant groups: they are *Oldenlandia corymbosa* L.; *Sesbania pachycarpa* de Candolle and *Cyperus esculentus* L. Similar results were obtained by identifying plant groups and their characteristic species on the basis of their affinity to environmental conditions (Dossou et al. 2012) and specifically the mode of weeding and fertilization in rice cultivation (Sanou, 2022). In this study, the majority of species remain indifferent to fertilizers.

However, the *C. esculentus* group, despite a low species richness, seems to have an affinity for treatments F5, F10 respectively.

However, according to Colbach et al. (2013), the effect of fertilization on weed floristic composition is primarily related to the facilitation of nutrient availability that it allows, rather than the type of fertilizer. The floristic composition could be related to the fact that poultry dung-based fertilizers improve the amount and availability of soil nutrients. Indeed, poultry manure in combination with mineral fertilizer can contribute to the improvement of soil fertility and ensure the sustainability of cropping systems (Gomgnimbou et al. 2019).

The average diversity indices including the Shannon (2.9 bits), Simpson (0.93 bits) and Piélou (0.96 bits) indices recorded for these three (03) plants groupings are quite low. These indices differ from those obtained by Dossou et al. (2012) who reported indices of the order of 4.3 bits for the Shannon index and 0.65 for the Piélou Equitability index of the plant groups of the Agonvè swamp forest in South Benin. This difference could be explained by the disruptive effect of cultivation practices in the cultivated fields.

In terms of number of tillers, rice straw biomass, and height, all fertilizer treatments improved the vegetative development of rice plants compared to the no-fertilizer control. These results corroborate those of Agbede et al. (2008), who also obtained better vegetative development of sorghum using poultry dung. However, the addition of BP to poultry dung appears to have a more efficient effect on rice development. These results corroborate those of Mahasen et al. (2012) who obtained the similar results in cotton crop. Weed dry biomass (27.4 g/m2) is much higher under manure fertilization at 7.5 t/ha. However, this infestation does not affect rice yield compared to the control without fertilizer. This could be explained by the fact that organo-mineral fertilization improves soil water status, improves nutrient availability and nutrient content (Ouattara, 1994). These results corroborate those of Hien (2004), who estimates that increasing manure rates can maintain sorghum yields between 1.5 and 3.5 tons/ha. The mode and type of organo-mineral fertilization improved rice yields (Chanda et al. (2021); Sanou et al. (2022)).

3.3. Conclusions and perspectives

This study has contributed to the identification of the impact of soil fertility management on floristic diversity and weed infestation in rainfed rice. The fertilizers used had an effect on weed dynamics and infestation. Indeed, the control plot without fertilization had the highest cover and abundance rates.

Dry biomass was higher with the application of poultry manure at 7 t/ha. The fertilization treatments explain 26.9% of the vegetation grouping. Three (03) herbaceous communities were identified on the basis of their affinity with the treatments. With regard to the agro-morphological parameters of the rice, it appears that they varied according to the types of fertilizers applied. Indeed, these parameters were favored by organo-mineral fertilization, mainly urea, poultry droppings and Burkina Phosphate.

In the future, it will be interesting to:

- to study the effect of organo-mineral fertilizers on the dynamics of the seed stock of weeds;

- to determine the effect of the content of the main soil nutrients on the distribution of weeds.

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References

Agbede TM, Ojeniyi SO, and Adeyemo AJ (2008). Effect of poultry manure on soil physical and chemical properties, growth and grain yield of sorghum in southwest Nigeria. *American-Eurasian Journal of Sustainable Agriculture*, 2(1): 72-77

Barralis G (1976). Méthodes d'études des groupements adventices des cultures annuelles : Application à la Côte D'Or. *Vème Coll. Inter. Biol., Ecologie Et Système des mauvaises herbes, Dijon*, pp59-68.

Chanda TA, Sarkar MAR, Perveen S, Hossain MM and Hasan AK (2021). Effect of variety and nitrogen fertilizer managements on the growth and yield of Transplant aman rice managements. *Res. Agric. Livest. Fish.*, 8 (3): 281-289.

Colbach N, Tschudy CD, Meunier D et Houot SNB. (2013). Weed seeds in exogenous organic matter and their contribution to weed dynamics in cropping systems. A simulation approach. *Europ. J. Agronomy* 45: 7– 19.

Dossou MF, Lougbégnon OT, Houessou GL, Teka SO et Tente AHB (2012). Caractérisation phytoécologique et structurale des groupements végétaux de la forêt marécageuse d'Agonvè et de ses milieux connexes au Sud-Bénin. *Journal of Applied Biosciences* 53 : 3821 – 3830

FAO, 2014. Analyse des incitations par les prix pour riz au Burkina Faso. Série de notes techniques, SAPAA, par Bazié, Y. G., Guissou, S. R., Ilboudo, W. F. A., Mas Aparisi, A. Rome. 62 p. www.fao.org/3/i4514f/i4514f.pdf (access date : 12.16.2021)

FAO, 2018. Suivi du marché du riz de la FAO, Volume XXI, Edition N° 1, 10p. www.fao.org/3/I9243FR/i9243fr.pdf (access date : 12.16.2021)

Freid G, Norton L. R, et Reboud X, 2008. Environmental and management factors determining weed species composition and diversity in France. *Agriculture, Ecosystems & Environment*, 128: 68-76.

Gomgnimbou APK, Bandaogo AA, Coulibaly K, Sanon A, Ouattara S, et Hassan Nacro HB (2019). Effets à court terme de l'application des fientes de volaille sur le rendement du maïs (*Zea mays* L.) et les caractéristiques chimiques d'un sol ferralitique dans la zone sud-soudanienne du Burkina Faso. *Int. J. Biol. Chem. Sci.* 13(4) : 2041-2052.

Hien E, 2004. Dynamique du carbone dans un acrisol ferrique du centre Ouest du Burkina : influence des pratiques culturales sur le stock et la qualité de la matière organique, Doctoral thesis (Unpublished), Ecole Nationale Supérieure Agronomique de Montpellier, France 138p

INSD, 2017. Bulletin trimestriel de conjoncture, 2eme trimestre. Direction des Statistiques et des Synthèses Economiques. Burkina Faso. 81 p.

Ouattara B (1994.) Contribution à l'étude de l'évolution des propriétés physiques d'un sol ferrugineux tropical sous culture : Pratiques culturales et états structuraux du sol. Doctoral thesis (Unpublished), Université Nationale, Abidjan, Côte d'Ivoire 153 p.

Ouédraogo M, Ouédraogo S, et Kaboré M (2011). Analyse de la compétitivité de la filière riz au Burkina Faso. PRESAO. Rapport Final N° 5- 2011-12 - Riz, 41 p.

Rahali A, M. Makhlouf M, et Benkherbache N (2010). Influence de l'itinéraire technique sur le stock semencier de mauvaises herbes de la zone semi-aride de Sétif. Département d'Agronomie, Université de M'sila, Pôle Universitaire de M'sila, 28000 M'sila (Unpublished), Algérie, 10 p.

Sanou A, Yonli D, Ouédraogo N, Kam H, Traoré K, Ouédraogo I, Somda I. et Traoré H, 2019. Farmers' perception, cropping patterns and weed management in rice (Oryza sp.) growth in Burkina Faso. *Agricultural, Science Research Journal*, Volume (9) Issue (5): pp 70 -79.

Sanou A, Yonli D, Traore K., Séré I, Kam H, Somda I, Traore H (2022). Integrated of soil fertility and weed management on lowland rice growth in Western Burkina Faso. *Agricultural Science Research Journal*, Volume (12) Issue (9) : 152 – 159

Traoré A, Traoré K, Traoré O, Bado BV, Nacro BH, et Sédogo MP, 2015. Caractérisation des systèmes de production à base de riz pluvial strict dans les exploitations agricoles de la zone Sud soudanienne du Burkina Faso. *Int. J. Biol. Chem. Sci*. 9(6) : 2685-2697.

Traoré H, et Maillet J, 1998. Mauvaises herbes des cultures céréalières au Burkina Faso, Agriculture et développement, (20), pp47-59.

Traoré K, et Mangara A, 2009. Etude Phyto-Écologique des Adventices dans les Agro-écosystèmes Élaeicoles de la Mé et de Dabou. UFR Sciences de la Nature, Université d'Abobo-Adjamé, Côte d'ivoire. *European Journal of Scientific Research*. ISSN 1450-216X Vol.31 No.4 (2009), pp 519-533.