RESEARCH ARTICLE

Zakaria Kiebre
Ernest Renan Traore
Mariam Kiebre
Pauline Bationo-Kando
Dramane Kabore
Boureima Sawadogo
Mahamadou Sawadogo

Agronomic performances and nutritional composition of three morphotypes of spider plant (*Cleome gynandra* L.) under different doses of compost

Authors' addresses:
Université Ouaga I Pr Joseph KI-ZERBO; 03 BP7021 Ouagadougou 03; Burkina Faso,
Unité de Formation et de Recherche en Sciences de la Vie et de la Terre Équipe Génétique et Amélioration des plantes, Laboratoire Biosciences.

Correspondence:
Zakaria Kiebre
Université Ouaga I Pr Joseph KI-ZERBO; 03 BP7021 Ouagadougou 03; Burkina Faso,
Unité de Formation et de Recherche en Sciences de la Vie et de la Terre Équipe Génétique et Amélioration des plantes, Laboratoire Biosciences.
Tel.: +22670691997
e-mail: kiebzak@yahoo.fr

Article info:
Received: ……
Accepted: …….

ABSTRACT

Spider plant is an important dietary supplement for the local population of Burkina Faso. The present study aims to evaluate the agronomic and biochemical response of three morphotypes to the variation of compost dose. The split-plot design with three repetitions was used for experiment. Three morphotypes, i.e slightly-violet, green and violet, were evaluated using four doses of compost. The results revealed that the agromorphological traits and biochemical composition vary considerably according to the compost dose. About 6t/ha was identified as the best for biomass production and nutritional profile of spider plant. In general, the agronomic response of morphotypes to the variation of compost dose is not significantly different, except biomass. However, under low fertility conditions, the green morphotype records the best performances whereas in high fertility conditions, the slightly-violet records the best performances. For the biochemical composition, the content of nutrients depends more of compost dose than morphotype.

Key words: Morphotype, *Cleome gynandra*, nutritional profile, compost, Burkina Faso

Introduction

The traditional leafy-vegetables play a significant role in the diet of local populations in Africa where they ensure the main part of the nutritional requirements (Kahane et al., 2005). Among them, spider plant (*Cleome gynandra* L.) was identified as leafy-vegetable of interest for the populations due to its high economic and nutritional value. It brings the essential nutrients for health, such as ion, phosphorus, vitamins, phenol compounds which are lacking in the main dishes. Its consumption is very beneficial for health (Gonye et al., 2017). Thus, spider plant constitutes a good dietary complement for the populations of developing countries, specially, those of Burkina Faso where several persons, in particular the children, suffer from chronic food shortages and nutrients deficiencies (Commission Européenne, 2015). In additional, it has others advantages, such as, easiness of production and fast growth.

Consumed for relish in Burkina Faso, spider plant is used for the cooking of several traditional food specialties. It is more and more produced in vegetables gardens (Kiébré et al, 2015) where the agronomic practices vary significantly due to the lack of adapted methods. However, the agronomic practices and the dose of fertilizers influence the agronomic performances and nutritional profile of vegetables (Leclerc et al., 1991, Gonye et al., 2017). Thus, this study aims to identify the appropriates doses of compost for good agronomic performances and good nutritional composition of spider plant. Specifically, the study aims to determine the effect of dose of compost on the agronomic performances and nutritional composition of three morphotypes of spider plant.

Materials and Methods

Plant material

Nine (9) genotypes from the germoplasm of Genetics and plant breeding team of University Ouaga I Professeur Joseph KI-ZERBO were used for the study. The genetic material was constituted of 3 accessions of green morphotype, 3 accessions of Slightly-violet morphotype and 3 accessions of violet morphotype (Figure 1). These morphotypes were identified by Kiébré et al. (2015).

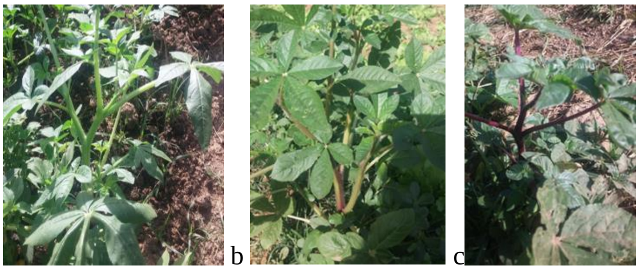

Figure 1. *Morphotypes of Cleome gynandra L. used for the study: a – green morphotype; b – slightly-violet morphotype; c – violet morphotype.*

Experimental Site

The study was conducted in rainy season (2016) at the research station of Gampela, agronomic research center of the Institute of Rural Development (IDR). Gampela is located in North-Sudan zone (1° 21' W and 12° 24' N), with an annual rainfall ranging from 600 to 900 mm (Thiombiano & Kampmann, 2010). The maximal annual temperature varies between 35 to 40°C and minimal temperature varies between 18 to 19°C.

Soil and compost characteristics

The compost used is produced in Burkina Faso and is intended for the gardening production. The soil of the study site and the compost were analyzed at Bureau National des Sols (BUNASOL) in order to determine their physicochemical characteristics like granulometry, rates of matter organic, carbon and nitrogen, the proportions of potassium available, assimilable phosphorus and pH of soil (Table 1).

Experimental design and trial management

The experiment was carried out according to split-plot design with three repetitions. The repetitions were separated by one meter distance. In repetition, each accession was represented by a row of 3 meters on which 7 hills were sown. The spaces between the rows and the plants were 0.5 meter. A thinning to one plant per hill was then done 10 days after sowing. Before starting trial, four doses of compost, i.e 0t/ha (control), 3t/ha, 6t/ha and 9t/ha, were applied.

Variables measured

Agronomic parameters

Except the number of days to 50 % flowering and the number of days to plants emergence, measured on the entire row, the others quantitative variables were measured on 4 plants by row 45 days after sowing. These are the plant height, the stem diameter; the number of primary branches; the length of leaflet (measured from the top from the pulvinus of the central leaflet); the width of leaflet (measured at the middle portion of the central leaflet); the length of petiole (measured to the sheath from the pulvinus), the peduncle length, the fruit length, the fruit width, the dry and fresh biomass of leaves.

Biochemical Parameters

The biochemical parameters were estimated for each morphotype and for each dose of compost. These are copper content (Cu), iron content (Fe), manganese content (Mn), zinc content (Zn), nitrogen content (N), potassium content (K), phosphorus content (P) and magnesium content (Mg). For the minerals Cu, Fe, Mn and Zn, about 5 g of dry leaves were mineralized at 100-340°C and these nutrients were estimated in presence of sulpho- nitro-perchloric solution, using atomic absorption 324.8, 248.3, 279.5 and 219.9 nm respectively. For N, K, P and Mg, the mineralization was carried out with mixture of selenium, sulfuric and salicyclic acid. Phosphorus content was measured using ammonium molybdate and ascorbic acid as indicators. Potassium content was determined using atomic absorption spectrophotometer at 285.2nm. The extraction of β carotene was carried out by hexane as solvent and its content was evaluate by HPLC method with a nucleosilyl C18 column (model SUPELCO LC 18). An UV visible spectrophotometer (Jasco V–530, Japan) was used. Mobile phase was acetronitrile – methanol – ethyl acetate (70 : 20 : 10, v / v / v) at pH = 8 and the detection was made at 450 nm in UV. Minerals contents were carried out at Bureau National des Sols (BUNASOL) whereas the beta carotene content was assessed at Instutut de Recherche en Sciences de la Santé (IRSS).

Statistical analysis

Data were analyzed using the GenStat v4.10.3 software (VSN International, 2011). Three-way analysis of variance (genotype-morphotype-dose of compost) was performed to determine the effect of factors on agronomic and biochemical parameters. The graphs were carried out using Excel 2010.

Table 1. *Soil and compost characteristics.*

Physicochemical characteristics		Soil	Compost
	Texture	Silty- Sandy	-
	Clay (< 2µ) (%)	11.76 - 13.73	-
Granulometry	Silt (%)	25.49 - 27.46	-
	Sand (50-200µ) (%)	58.82 - 62.75	-
Matter organic	Matter organic (%)	0.957 - 1.646	40.74
	Carbon (%)	0.555 - 0.955	23.63
Minerals	Nitrogen (%)	0.046 - 0.071	1.36
	Carbon/Nitrogen	12.00 - 14.00	17.00
	Potassium available (ppm K)	84.18 - 101.23	04.02
	Phosphore assimilable (ppm P)	9.71 - 10.91	02.47
pH	Eau	5.26 -5.64	06.12

Results

Agronomic performances of morphotypes according to the compost dose variation.

Very weak non- significant variations were observed between the 9 genotypes used. The plants emergency which vary between 3 and 5 days is independent of morphotype (p= 0.463) and compost dose variation (P = 0.167). The fresh biomass varied from 60.96 to 115.60g for the Slightly-violet morphotype, from 48 to 96 g for the green morphotype and from 63 to 78 g for the violet morphotype. The Slightly-violet morphotype recorded the best agronomic performances i.e 89.10 g and 115.60 g, respectively for 6t/ha and 9t/ha. It is followed by green morphotype which, for the same doses, recorded 84.83 g and 95.60 g respectively. But with low doses of compost (0t/ha and 3t/ha), the performances of violet morphotype are higher than those of the others (Table 2). In fact, a significant interaction between dose and compost was observed (< 0.001). Significant differences were also observed between the morphotypes (< 0.001) and compost doses (< 0.001) (Table 3).

As for the dry biomass, it varied from 10.60 to 19.53g for the Slightly-violet morphotype, from 8.53 to 14.53g for the green morphotype and from 11.10 to 13.03g for the violet morphotype. The Slightly-violet morphotype recorded the best agronomic performance, 19.53g for 9t/ha. It is followed by green morphotype which recorded 14.13g and 14.53g for 6t/ha and 9t/ha, respectively. However, with low doses of compost (0t/ha and 3t/ha), the violet morphotype has the most interesting performances than the others (Table 4). The analysis of variance (Table 5) showed significant differences between the three morphotypes (P < 0.001) and between the compost doses (P < 0.001). A significant interaction between dose-morphotype (P < 0.001) was also observed.

A non-significant variation (P = 0.068) was observed for the plant cycle which varied from 26 to 28 days for Slightly-violet morphotype and from 23 to 27 days for the others morphotypes (Table 6). Considering compost doses, the variation was significant (P = 0.018) between them; the plant cycle becomes increasingly long when the dose of compost increases.

No significant variation was reported between the morphotypes for the diameter of plants (P = 0.189). But, the analysis of variance indicates significant differences between the doses of compost (P = 0.005). The best performances were observed for the doses 3t/ha and 6t/ha (Table 7).

At 45 days after sowing, the plant height varied from 60.5 to 83 cm for the Slightly-violet morphotype, from 48.75 to 86.92 cm for the green morphotype and from 50.19 to 89.29 cm for the violet morphotype (Table 8). The best agronomic performances were observed with 3t/ha (for the Slightly-violet and violet morphotypes) and 6t/ha for the green morphotype. The analysis of variance (Table 9) showed significant differences between doses of compost (<0.001) and non-significant variations between morphotypes (< 0.526).

Non-significant differences were observed neither between the morphotypes, nor between the doses of compost for the leaflet width and length, the fruit width and length, the petiole length, the peduncle length and the number of primary branches. The leaflet width and length varied, respectively, from 2 to 4 and 5 to 8 cm. As for the length and with of the fruit, they varied respectively from 6 to 12 cm and from 3 to 7 cm. For the peduncle length, it varied from 3 to 5 cm while the number of primary branches varies from 4 to 7 for each morphotype.

Table 2. *Mean performances (g) of fresh biomass according to the variation of compost dose.*

Compost dose	Slightly-violet	Green	Violet
0t/ha	60.96	74.19	73.09
3t/ha	66.70	48.86	78.96
6t/ha	89.10	84.83	69.06
9t/ha	115.60	95.60	63.00

Table 3. *Analysis of variance for mean performances of fresh biomass according to the compost dose variation*.

Source of variation	df	SMG	SME	F statistic	P value
Dose of compost	3	2953.002	984.334	285.82	<0.001
Morphotype	2	137.400	68.700	19.95	<0.001
Dose-morphotype	6	5972.570	995.428	289.04	<0.001
Residual	12	1.327	3.444		
Total	23	9104.300			

Legend: df: degree of freedom, SMG: means squared of genotype, SME: means squared of the residual.

Table 4. *Mean performances (g) of dry biomass according to the compost dose variation*.

Dose of compost	Slightly-violet	Green	Violet
0t/ha	10.60	13.25	13.03
3t/ha	10.75	8.53	12.53
6t/ha	12.33	14.13	11.66
9t/ha	19.53	14.53	11.10

Table 5. *Analysis of variance for mean performances of dry biomass according to the variation of compost dose.*

Source of variation	df	SMG	SME	F statistic	P value
Dose of compost	3	605.752	20.1917	146.41	<0.001
Morphotype	2	6.0211	3.0105	21.83	<0.001
Dose-morphotype	6	97.0883	16.1814	117.33	<0.001
Residual	12	1.6550	0.1379		
Total	23	165.3395			

Legend: df: degree of freedom, SMG: means squared of genotype, SME: means squared of the residual

Table 6. *Plant cycle (days) according to the compost dose variation.*

Dose of compost	Slightly-violet	Green	Violet
0t/ha	27.00	23.25	23.56
3t/ha	26.00	24.50	23.50
6t/ha	26.50	27.00	26.00
9t/ha	28.00	27.00	27.00

Table 7. *Mean performances of plant diameter (cm) according to the compost dose variation*.

Dose of compost	Slightly-violet	Green	Violet
0t/ha	1.490	1.855	1.842
3t/ha	2.003	2.256	2.515
6t/ha	1.916	1.812	1.896
9t/ha	1.585	1.690	1.695

Table 8. *Mean performances of plant diameter (cm) according to the compost dose variation.*

Dose of compost	Slightly-violet	Green	Violet
0t/ha	60.50	48.75	50.19
3t/ha	83.00	64.50	89.29
6t/ha	82.83	86.92	83.17
9t/ha	73.83	79.50	76.00

Table 9. *Analysis of variance of mean performances of the plant height according to the compost dose variation.*

Source of variation	df	SMG	SME	F statistic	P value
Dose of compost	3	3413.21	1137.74	11.85	<0.001
Morphotype	2	130.46	65.23	0.68	0.526
Dose-morphotype	6	751.43	125.24	1.30	0.327
Residual	12	1152.61	96.05		
Total	23	5447.71			

Biochemical composition of morphotypes according to variation of compost doses

The content of β carotene varied from 3269.8 to 3861.8µg/g FW for the Slightly-violet morphotype, from 3482.2 to 4264 ug/g FW for the green morphotype and from 3082.5 to 3680.2 ug/g FW for the violet morphotype. The green morphotype recorded the highest performances (4264 ug/g FW for 6t/ha and 425ug/g FW for 9 t/ha) compared to the others morphotypes. It is followed by Slightly-violet morphotype (3845 ug/g FW for 6t/ha and 3861ug/g FW for 9 t/ha) whereas the violet morphotype records the weakest performances (3680.2 ug/g FW for 6t/ha and 3662.2 ug/g FW for 9 t/ha). According to the dose of compost, the 6t/ha and 9t/ha present the highest contents for the three morphotypes (Figure 2). The analysis of variance showed significant differences between the morphotypes (< 0.001) on the one hand and between the doses of compost (< 0.001) on the other hand (Table 10). Also, these analysis showed a significant interaction between the dose of compost and the morphotype (P = 0.004).

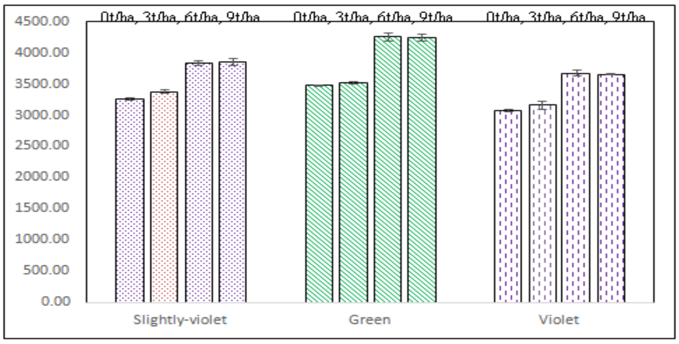

Figure 2. *Beta carotene content of the morphotypes according to the compost doses variation.*

The phosphorus varied from 5.04 to 6.17mg/g DW for the Slightly-violet morphotype, from 4.86 to 6.30 mg/g DW for the green morphotype and from 4.68 to 5.22 mg/g DW for the violet morphotype. Although this variation is not significant, the green morphotype recorded the performances (6.30 mg/g DW for 6t/ha and 5.58 mg/g DW for 3 t/ha) higher than the others morphotypes. It is followed by Slightly-violet morphotype (6.17 mg/g DW for 9t/ha and 5.40 mg/g DW for 6 t/ha) whereas the weakest performances were observed for the violet morphotype (5.22 mg/g DW for 3t/ha and 5.04 mg/g DW for 9 t/ha). The variation of performances is not significant between the compost doses (Figure 3).

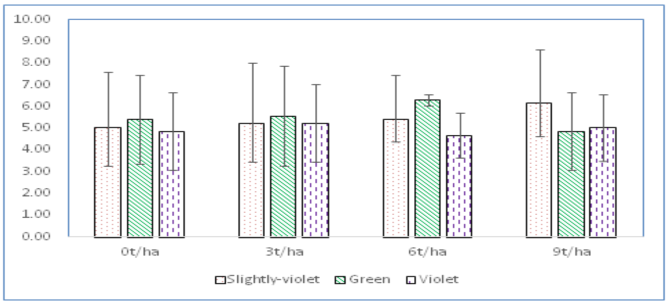

Figure 3. *Phosphorus content of the morphotypes according to the compost dose variation.*

Non-significant variations were observed for the potassium content between the morphotypes (P = 0.880) and the doses of compost (P=0.932). The potassium content varied from 22 to 24 mg/g DW for all the morphotypes (Figure 4).

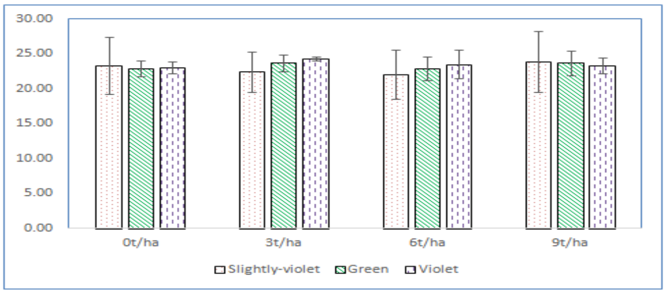

Figure 4. *Potassium content of the morphotypes according to the compost dose variation.*

For the iron content, a variation from 285 to 523 mg/g DW was observed for the Slightly-violet morphotype, a variation from 332 to 366 mg/g DW for the green morphotype and a variation from 322 to 464 mg/g DW for the violet morphotype. The Slightly-violet morphotype recorded the highest performances (523 mg/g DW for 9t/ha). It is followed by the violet morphotype (464 mg/g DW for 6 t/ha) whereas the green morphotype records the weakest performances (366 mg/g DW for 0t/ha). However, these non-significant variations (Figure 5) are independent of the morphotype (P = 0.943) and of the dose of compost (P = 0.914).

As for the zinc content, it varied from 3.27 to 11.19 mg/g DW for the Slightly-violet morphotype, from 7.14 to 9.44 mg/g Dw for the green morphotype and from 1.14 to 9.84 mg/g Dw for the violet morphotype (Figure 6). The Slightly-violet morphotype recorded the highest performances (11.19 mg/g DW for 6t/ha) compared to the others morphotypes. It is followed by violet morphotype (9.84 mg/g DW for 0t/ha) whereas the green morphotype records the weakest performances (9.44 mg/g DW for 6t/ha). The analysis of variance (Table 11) showed significant differences between the doses of compost (< 0.001) but not between the morphotypes (P = 0.059). These analyses showed also an significant interaction between dose of compost and morphotype (P = 0.047).

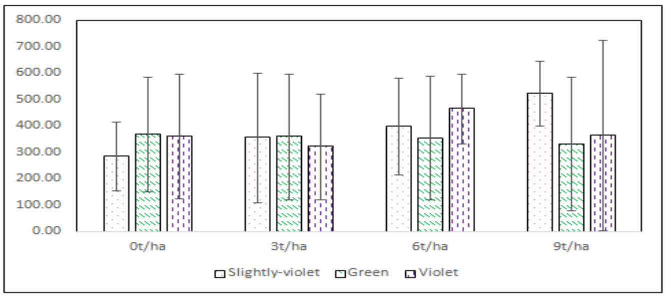

Figure 5. *Iron content of the morphotypes according to the compost dose variation.*

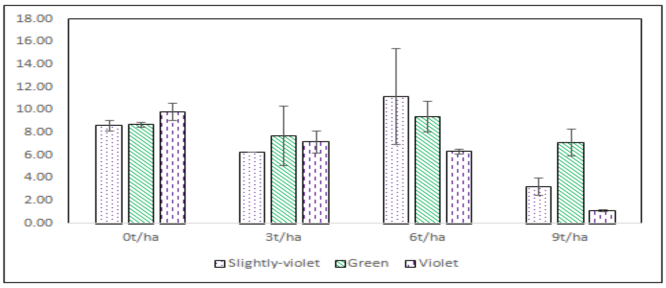

Figure 6. *Zinc content of the morphotypes according to the compost dose variation.*

The magnesium content (Mg) varied from 0.72 to 1.27 mg/g DW for the Slightly-violet morphotype, from 0.73 to 2.17 DW mg/g for the green morphotype and from 0.82 to 1.58 mg/g DW for the violet morphotype. The green morphotype recorded the high performances (2.17 mg/g DW for 0t/ha) compared to the others morphotypes. It is followed by the violet morphotype (1.58 mg/g DW for 0t/ha). As for the Slightly-violet morphotype, it records the weakest performances (1.27 mg/g DW for 9 t/ha). Non-significant differences were recorded neither between the morphotypes nor between the doses of compost (Figure 7).

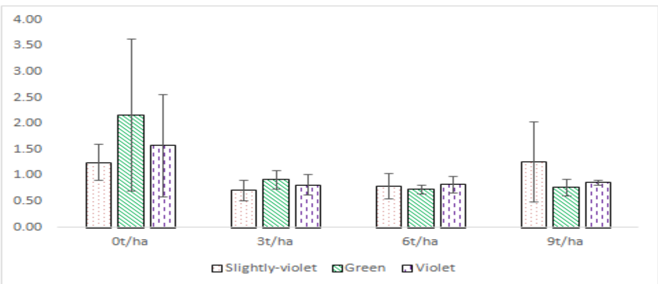

Figure 7. *Magnesium content of the morphotypes according to the compost dose variation.*

The content of copper (Cu) varied from 5.44 to 9.39 mg/g DW for the Slightly-violet morphotype, from 4.54 to 6.24 mg/g DW for the green morphotype and from 3.04 to 5.69 mg/g DW for the violet morphotype. Although the variation is non-significant (P = 0.901), the Slightly-violet morphotype recorded the best performances (9.24 mg/g DW for 9t/ha and 9.39 mg/g DW for 6t/ha) compared to the others morphotypes (Figure 8). It is followed by green morphotype (6.24 mg/g DW for 9t/ha) while the violet morphotype records the weakest performances (5.69 mg/g DW for 3t/ha). Considering the doses of compost, the best performances were recorded for 6t/ha and 9t/ha (Figure 8). But, differences were non-significant between them (P = 0.388).

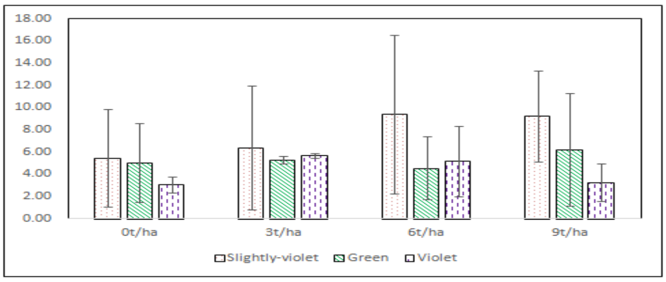

Figure 8. *Copper content of the morphotypes according to the compost dose variation.*

Very weak non-significant variations of the nitrogen content were observed between the morphotypes and the doses of compost. The nitrogen content varied from 3 to 3.5 mg/g DW for the morphotypes. For the manganese content, a significant variation (Table 12) was observed between the morphotypes (P = 0.030) and between the doses of compost (< 0.003). Its content varied from 69.8 to 87.9 mg/g DW for the Slightly-violet morphotype, from 65.1 to 82.9 mg/g DW for the green morphotype and from 59.7 to 76.7 mg/g DW for the violet morphotype. The Slightly-violet morphotype recorded the highest performances (87.9 mg/g mg/g for 6t/ha) compared to the others morphotypes. It is followed by the green morphotype (82.9 mg/g DW for 9 t/ha) whereas the violet morphotype presents the weakest performances (76.7 mg/g DW for 9 t/ha). The best performances were observed for 6t/ha and 9t/ha (Figure 9).

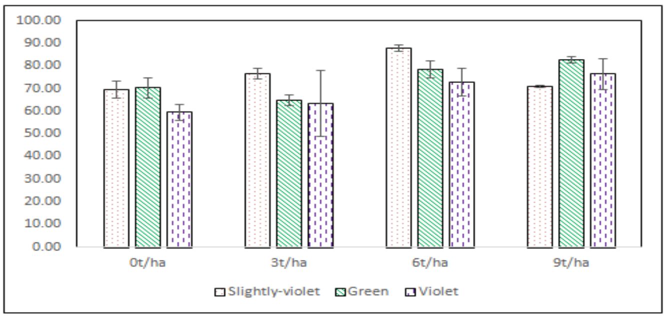

Figure 9. *Manganese content of the morphotypes according to the compost dose variation.*

Table 10. *Analysis of variance of mean performances of Beta carotene content of the morphotypes according to the compost dose variation.*

Source of variation	df	SMG	SME	F statistic	P value
Dose of compost	3	2234875	744958	406.47	<0.001
Morphotype	2	952346	476173	259.82	<0.001
Dose-morphotype	6	65967	10994	6.00	<0.004
Residual	12	21993	1833		
Total	23	3275180			

Legend: df: degree of freedom, SMG: means squared of genotype, SME: means squared of the residual

Table 11. *Analysis of variance of mean performances of Zinc content of the morphotypes according to the compost dose variation.*

Source of variation	df	SMG	SME	F statistic	P value
Dose of compost	3	107.653	35.884	14.09	<0.001
Morphotype	2	18.402	9.201	3.61	<0.001
Dose-morphotype	6	46.623	7.770	3.05	<0.004
Residual	12	30.561	2.547		
Total	23	203.239			

Legend: df: degree of freedom, SMG: means squared of genotype, SME: means squared of the residual

Table 12. *Analysis of variance of mean performances of manganese content of the morphotypes according to the compost dose variation.*

Source of variation	df	SMG	SME	F statistic	P value
Dose of compost	3	735.54	245.18	8.10	<0.003
Morphotype	2	289.34	144.67	4.78	<0.030
Dose-morphotype	6	430.60	71.77	2.37	<0.096
Residual	12	363.24	30.27		
Total	23	1818.73			

Legend: df: degree of freedom, SMG: means squared of genotype, SME: means squared of the residual

Discussion

The agronomic performances observed, in particular biomasses, plant height and plant cycle, indicate that the doses 6t/ha and 9t/ha record the best yields of biomass. For these doses of compost, the plant height, the plant cycle, the biomass are similar to the observations of Gonye et al. (2017) who observed significant variations on biomass yield. They are also similar to those of Garjila et al. (2017) who recorded significant differences between the doses of compost for plant height and stem diameter. But in this study, non-significant difference was observed for the number of primary branches. This result, different of observation of Garjila et al. (2017) would be explained by the differences between the composts and the genotypes used.

In general, the Slightly-violet morphotype recorded the best agronomic performances for the highest doses i.e 6t/ha and 9t/ha. In contrary, with the lowest dose of compost i.e 3t/ha, it is the green morphotype which records the best performances. These results, explained by the significant interaction dose-morphotype, suggest that the producers must take account of the fertility of their soil in the choice of the morphotype to produce. Thus, the green morphotype would be appropriate better for weak fertility soils whereas the Slightly-violet morphotype would be appropriate better for very fertile soils.

The results observed indicate that the doses 6t/ha and 9t/ha record the best contents of β-carotene and minerals. They indicate also that beyond 6t/ha, the contents do not increase more significantly, suggesting thus that this dose of compost is the maximum threshold, necessary for a good nutritional profile. Any increase in the dose of compost beyond 6t/ha is useless, sometimes even toxic for the plant, leading to weak performances. This result is very interesting for the producers of Burkina Faso who will be able to determine the necessary quantity of compost for their spider plant gardens.

In general, the β-carotene content observed is higher than those observed by Agbo et al. (2014). This difference would be explained by the compost used, the period of trial or by the difference of the genotypes used. Indeed, there is a seasonal variation of the biochemical composition of spider plant (Agbo et al., 2014). The β-carotene content observed in this study, higher than those observed by Soro et al. (2012) on others traditional leafy-vegetable of Africa, such as amaranth and jute, indicates that spider plant can contribute significantly to the fight against the vitamin A deficiencies.

Former studies reported that, the nutritional composition of varieties with dark color are, in general, higher than those with green color (Kahane et al., 2005). However, except Zn and Mn, the results of this study indicate that the content of nutrients is not associated to the color of the morphotype. The biochemical composition is most related to dose of compost applied than morphotype. This result constitutes a interesting information for the consumers and the producers of Burkina Faso who prefer green morphotype more than the dark ones (Kiébré et al., 2015).

Conclusion

The study identified 6t/ha as the best to ensure a good productivity of biomass and a good nutritional composition of morphotypes of spider plant. Thus, this dose could be proposed to the producers of Burkina Faso. The response of the three morphotypes to the variation of compost dose is approximately similar, indicating that the biochemical composition and biomass productivity depend mainly of the compost dose. However, in conditions of weak fertility of soil, the agronomic response of the green morphotype is more interesting than the others whereas in conditions of high fertility of soil, the Slightly-violet one is appropriate better. This study shows that spider plant has high nutritional value, specially, in beta-carotene and iron. It could contribute to fight against the diseases related to the nutritional deficiencies in Burkina Faso. In Burkina Faso, leaves of spider plant are generally consumed after cooking. So, it would be interesting to evaluate the biochemical composition of leaves after cooking to better evaluate the nutritional contribution of this traditional leafy-vegetable in the diet of the local population.

Acknowledgements

This research has been supported by International Foundation for Science (IFS), Sweden, through a scholarship given to Zakaria KIEBRE.

References

Agbo AE, Kouamé C, Anin AOL, Soro LC, N'zi J-C, Fondio L, Gnakri D. 2014. Seasonal variation in nutritional compositions of spider plant (*Cleome gynandra* L.) in south Côte d'Ivoire. *Int.* J. Agr. Pol. Res., 2: 406-413.

Commission européenne, 2015. Aide humanitaire et protection civile. Fiche-info ECHO – Burkina Faso – juillet 2015 3 p.

Garjila YA, Shiyam JO, John R. 2017. Effect of Cowdung Compost Manure Rates of Application on the Growth and Leaf Yield of Spider Plant (Cleome gynandra L. Briq) in Jalingo, Taraba State, Nigeria. Int. J. Cur. Res., 7(2): 1-6.

Gonye E, Kujeke GT, Edziwa X, Ncube A, Masekesa RT, Icishahayo D, Matikiti A, Chabata, 2017. Field performance of spider plant (*Cleome gynandra* L.) under different agronomic practices, 17(3): 12179 -12197.

Kahane R, Temple L, Brat P, Bon H. 2005. Les légumes feuilles des pays tropicaux: diversité, richesse économique et valeur santé dans un contexte très fragile. Colloque Angers, 10p.

Kiébré Z, Bationo-Kando P, Sawadogo N, Sawadogo M, Zongo JD. 2015. Selection of phenotypic interests for the cultivation of the plant *Cleome gynandra* L. in the vegetable gardens in Burkina Faso. J. Exp. Biol. Agr. Sci., 3(3): 288-297.

Leclerc J, Miller Ml, Joliet E, Rocquelin G. 1991. Composition minérale et vitaminique de la carotte et du céleri-rave selon le mode de fertilisation. Reproduction Nutrition Développent, EDP Sciences, 31(3): 315-315.

Soro CL, Ocho-Anin Atchibr IAL, Armand KKK, Christophe K. 2012. Evaluation de la composition nutritionnelle des légumes feuilles. J. Appl. Biosci., 51: 3567 – 3573.

Thiombiano A, Kampmann D, (ed). 2010. Atlas de la biodiversité de l'Afrique de l'Ouest, Tome II : Burkina Faso, Ouagadougou et Frankfurt/Main.