Influence of six urban compost types on sorghum growth and yields in Donsin, sudan-sahelian area of Burkina Faso

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Abstract
An experiment was implemented for three years in the sudan-sahelian area of Burkina Faso to assess the effects of six types of urban composts on sorghum growth and yield. These composts were elaborated from the mixture of different initial substrates such as slaughterhouse waste (SW), green waste (GW), cooking waste (CW). The field experiment was a randomized complete with four replicated blocks and seven randomized treatments in each block. Results showed that the plant growth, the grain and straw yields were influenced by compost types. Height plant were higher for compost 3 (30 % SW, 30 % GW and 40 % CW) and compost 2 (40 % SW, 20 % GW and 40 % CW). All composts significantly increased sorghum grain and straw yields compared to control.

Introduction
In the sudan-sahelian zone of West Africa 90% of the people live in rural zones and gain their livelihood from subsistence agriculture [1]. In this area soil fertility management is based on organic matter recycling. Moreover, the traditional agricultural system uses few chemical inputs to improve crop production. Soil infertility is the major cause of low crop yields in these areas [2]. Many authors cite soil low content in organic matter to be the main problem of soil poverty [3]; [4]. Crop residue is firstly use to feed animals or for energy or other household use so that it is not available to product manure or compost. In the peri urban zone, farmers try to resolve this problem by valorizing urban waste. In Ouagadougou, urban waste production was annually evaluated to 300 000 tons in 2000 [5]. For instance near the city of Ouagadougou (Burkina Faso), farmers use without any treatment these urban wastes to fertilize the cropped soils. Although these practices improve crop production, they also lead to health risks on the population and the environment ([6]. One of the solutions advocated to solve this issue is composting biodegradable component of these urban wastes. Studies on these different composts on sorghum growth are scarce in Burkina Faso. The objective of the study was to compare the effects of different urban composts elaborated from different initial mixed materials, on sorghum plant growth and yields.

Materials and methods
Field experiment
The experiment was implemented for three years in Donsin in the sudan sahelian area of Burkina Faso. Donsin is 23 km away from Ouagadougou. The climate is semi-arid with 4 months (from June to September) duration of rainy season. In this site soils are degraded because of climate change and human heavy pressure on natural resources. Crop production system is extensive without any organic restitution to the soil. Six urban compost types were assessed. These composts were elaborated from mixtures of different initial materials: slaughterhouse waste (SW: ruminants paunch contents), green waste (GW: tree leaves) and vegetables waste (CW: household and market refuses mainly vegetables). These substrates were mixed at different ratios to constitute initial compost mixtures. The six compost types were the following: compost 1 (C1): 60% SW + 40% GW; compost 2 (C2): 40% SW + 20% GW + 20 CW; compost 3 (C3): 30% SW + 30% GW + 40% CW; compost 4 (C4): 20% SW + 40% GW + 40% CW; compost 5 (C5): 40% GW + 60% CW; compost 6 (C6): 100% GW. Windrow composting technique was

used for 4 months. The field experiment was a randomized complete with four replicated blocks. The seven randomized treatments in each block were the six compost types and a control without organic matter application (TA). All plots (5 m x 4 m), received 3 $Mg.ha^{-1}.year^{-1}$ of compost. Plant material used was SARIASO11 (improved sorghum variety). Sowing density was 80 x 40 cm. Plant heights were weekly measured. The grain and straw yields were also measured at maturity. Straw were harvested, oven dried and weighted to assess the biomass production.

Data analysis

All data measured were submitted to ANOVA to test equalities of the means of the measured variables (grain and straw yield) using *XL*STAT-Pro 5.1 v5 software. A multiple range test at 95% confidence level was performed using NEWMAN-KEULS method to range the means.

Results and discussion

The plant growth was influenced by compost types. Heights were higher for compost 3 and compost 2. All composts significantly increased sorghum height compared to control at 82 days after sowing (DAS) (fig.1 A). The weekly plant height increase grew from 33th to 47th DAS, in particular in compost 6 where the increase reached 25 cm comparatively to an increase of 15 cm in the control. It decreased after 47th DAS. At 75th DAS the plant growth was ended (fig.1 B). Sorghum grain yield was higher for all composts comparatively to the control. The compost 3 gave the higher grain yield, + 38% by comparison to the control. There was no statistical difference ($P < 0,05$) for grain yields between C1, C2, C4 and C5 on the one hand and on the other hand for C6 and TA (table 1). Despite the low straw yield in the control, there was no statistical difference ($P < 0,05$) between TA and the other composts (table 1) due to a high variability. The addition of urban composts had a positive effect on sorghum growth and yields as reported in different previous studies in Burkina Faso with urban waste composts [5], household wastes [7]. The better plant growth and the highest yields of the organic inputs treatments were attributed to positive effects of the organic materials on soil physical and chemical properties, such as moisture retention, texture improvement, pH regulation and addition of micronutrients [8]; [9]. The Compost 3 performance on sorghum growth and yields is attributed to the relative balance of initial substrates with a few excesses of the vegetable wastes (CW) which are recognized to have a quick biodegradation and to play the role of composting activator because of their high nitrogen content [10]. Indeed, nitrogen positive effect on plant development in the semi-arid zone of Africa has been reported by many authors [3]; [11]

Table 1: Effect of compost types on sorghum grain and straw yields.

Compost types	Grains yield		Straw yield	
	Mean (kg.ha-1)	CV (%)	Mean (kg.ha-1)	CV (%)
C1	720**ab**	37	1700**a**	11
C2	756,25**ab**	34	1687,50**a**	18
C3	1212,5**a**	23	1825**a**	40
C4	730**ab**	72	1937,50**a**	33
C5	632,5**ab**	25	1525**a**	41
C6	540**b**	40	1462,50**a**	49
TA	457,5**b**	17	1262,50**a**	38

Means in the same column with the same letter or group of letters are not significantly different ($P < 0,05$) (Test Newman-Keuls).

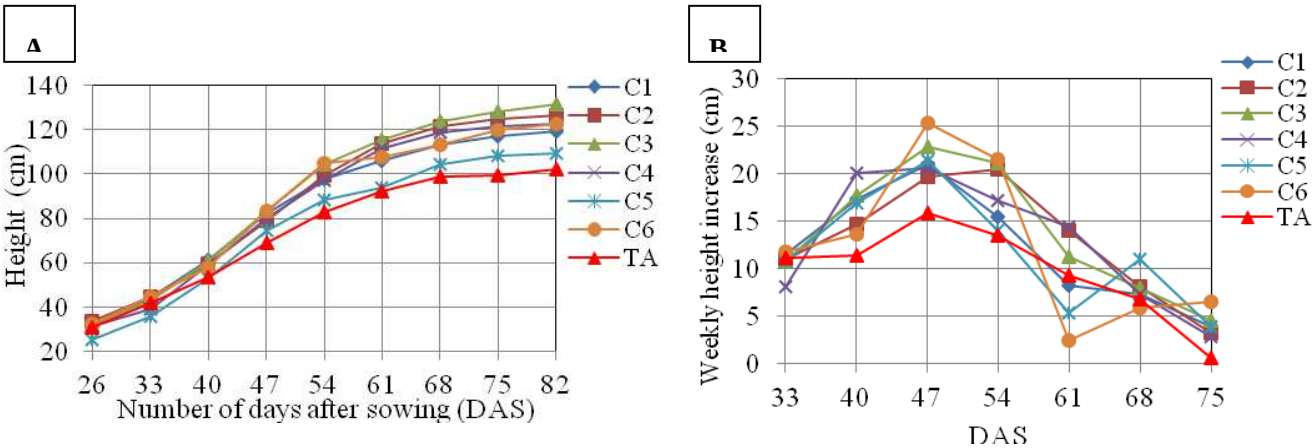

Fig.1: Effects of the six composts types on (A) sorghum growth and (B) weekly height increase

Conclusion and perspectives

Urban composts improved sorghum grain and straw yields. The rate of initial substrates used for composting had an effect on sorghum development. In perspective, research should be directed to find best formula of composting material mixing to achieve best agronomical value of compost for quantitative and healthy cereal production in the semi-arid zone of Africa.

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