Effects of *Zaï*Pit Depth on Morphological Traits, Yield Componentsand Yield of Cowpea (*Vigna unguiculata*(L.) Walp) in Burkina Faso

ABSTRACT:

Cowpea is the leading food legume for many households in arid and semi-arid regions of Sub-Saharan Africa. The erratic rainfall leads to cowpea yield decrease. The *Zaï*pit technology is an ancestral agricultural technique used for water and fertilizer management in crops production for increasing productivity. A study was carried out in Burkina Faso at Kamboinsin and at Kouare with for objective of evaluating the effects of *Zaï*depth on cowpea yield and yield components. Treatments consisted of the use of three *Zaï*depths (control (tillage); 15 cm; 25 cm) and four cowpea varieties. The experimental design was a split-plot replicated three times. Yield and yield components data were collected and submitted to an analysis of variance using JMP Pro 10 software. The results showed thatfor all the studied varieties, all the yield components and yields average values increased with the *Zaï*pit depth. *Zaï*of 25 cm and 15cm depth increased cowpea grain yield of more than 87% and 50% respectively compared to the control (tillage). Twenty-five-centimetre *Zaï*depth substantially enhances cowpea agronomical performances and is recommendable for cowpea production in drought prone regions or of low rainfall.

Key words: *Zaï*, *Zaï*depth, cowpea, yield.

1. INTRODUCTION

Agriculture is the main backbone for food and livelihood procurement of many households in sub-Saharan African countries. In Burkina Faso, 95% of the population relies on agriculture and livestock and the economy strongly rainfed agriculture dependent (FAO, 2012; Kim *et al.*, 2017). However, agriculture is affected by climatic variability, characterized by an irregularity and a high spatio-temporal variability of rainfall with sag trend (FAO, 2015). The erratic rainfall distribution combined with soils physical and chemical degradation and the use of inappropriate farming practices are the major causes of crops yieldsdecrease (Bado, 2002). The affected crops include legumes such as cowpea, the fourth food crop in Burkina Faso (Ty et al., 2015). Pedoclimatic stresses, the erratic rainfall and high temperatures are the major problems faced by cowpea producers (Ahmad & Ibrahim, 2013; Toudou *et al*., 2018). These constraints affect both fodder and grain yield. Cowpea fodder and grain yield losses in drought stress conditions were estimated at 62% and 56% respectively, when sowing was done in ploughed soil (Mofokeng & Mashingaidze, 2019). This decrease in cowpea productivity affects food availability and nourishment quality. In effect, cowpea grain contains 23 to 30% of protein, making it the main source of vegetal protein for many rural populations, 50 to 67% of starch, vitamins β complex such as folic acid (vitamin B) playing animportant role in preventing malformations in the new-borns(Boukar *et al*., 2011). Farmers are food self-sufficient when they depend on their own production. Traditional practices known to allow soil water and nutrients conservation in the cropping field are successfully used by many farmers to mitigate the negative impacts of drought on crops and increase yields. Those practices include practices such as rock-bunds and the zai pits technic (Sawadogo, 2017).

The *Zaï*is an ancestral agricultural practice used for organic manure and water management in crops production and for regenerating poorest parts of the fields if less lands are available (Kaboré *et al*., 2004; Partey *et al*., 2018). It consists of digging pits of 15 to 20 cm diameter and 20 to 40 cm depth, the spacing between two holes depending of the crop (Barro *et al.*, 2001). By the first rains, farmers put around 300 to 500 g of organic matter within the holes and the sowing occurs one or two weeks later (Zougmore, 2003). The origin of the *Zaï*technology is difficult to determine with precision. Some authors argued that Burkina Faso is the ancestral home of this practice, while others pointed it to Dogon region in Mali from where it has been imported into Burkina Faso by farmers of north of the country, especially of Yatenga Province after the dryness of 1970s(Danjuma & Mohammed, 2015; Partey *et al.*, 2018). In Burkina Faso, the word *Zaï*comes from « *zaïégré* » in Moore language that means « to wake up early and make his ground ready ». It is also called *Tassa* technic in Tahoua in Niger (Wouterse, 2017). On the higher fields, the *Zaï*increases 4 times red sorghum and 2.5 times pearl millet yields in comparison to the control conditions(Sawadogo, 2017). Water collection by *Zaï*pit is estimated at about 25 % of run-off coming from 5 times its area(Malesu *et al*., 2006). An adequate use of the *Zaï*technic can increase production by about 500 %(World Bank, 2005).In Burkina Faso, the *Zaï*technique is mostly used by farmers for sorghum and pearl millet growing to the detriment of legumes such as cowpea. The use of *Zaï*practices can enable mitigating the erratic rainfall effects on cowpea production and help improving productivity. The study aims at contributing to the use of appropriate agricultural system in cowpea production through *Zaï*pits technique. The specific objectives are: (i) determining the impact of *Zaï*practice in cowpea agronomical performancein Burkina Faso; (ii) evaluating the effects of *Zaï*depth on cowpea yield and yield components.

2. MATERIALS AND METHODS

2.1 Experimental sites

The experiments were conducted in Burkina Faso during 2020 and 2021 dry seasons in Kamboinsin agricultural and environmental research and training centre (CREAF), one of the Regional Centres of the Institute of Environment and Agricultural Research (INERA). This centre is located in the northeast region of Ouagadougou, the capital city of the country at 12°28' north and 01°33' west at 300 m above sea level. The second location was Kouare located in the Eastern region of the country at 12°03’36’’N and 00°21’ 55’’ E.at 400 m above level zero of sea.The climate of both locations is of north-soudanian type characterized by a long dry season from November to May and a rainy season from June to October, the rainfall varying from a year to another.

2.2 Treatments and experimental design

Treatments consisted of the use of two factors, especially the *Zaï*pit at three different depths (control (tillage); 15 cm depth and 25 cm depth) and the variety at four levels (Gorom local, Moussa local, KVx396-4-5-2D, Tiligre). The experimental design used was a split-plot with three replications. The *Zaï*system was the main factor and the variety the sub factor.

2.3 Cultural practices

Land preparation

The land preparation consisted of digging holes of 15 and 25 cm depth for*Zaï*and a tillage for the control. The holes' implementation was manually done in line of 3 m. The inter-row and intra-row spacing were of 80 cm and 40 cm respectively.

Sowing operation

The sowing was done in each experimental plot after the land preparation. A day before sowing, all the plots were well irrigated and the sowing occurred the morrow. For the treatments 15 cm and 25 cm *Zaï*depth, the sowing was done at the depth of the holes. For the control (tillage), sowing lines of 3 m length were laid out with the same inter-row and intra-row spacing than *Zaï*pits (80 cm and 40 cm).

2.4 Crop maintenance practices

Weeding

Weed management within each experimental field was done by manual hoe.

Fertilization

The NPK (14-23-14) at the rate of 100 kg per hectare, was applied as fertilizer one week after sowing to favour a good development of plants.

Pesticide application

The plants protection against crops pests during their reproductive stage was done by applying the Delta cal insecticide at the dose of 20 ml per 2 litres of water at the beginning flowering and the beginning of pods formation using spraying method.

2.5 Data collection

The following growth and yield related data were collected: plant height, number of branches per plant, above ground biomass, leaf chlorophyll content, pod length, number of pods per plant, pod weight per plant, number of grains per pod, 100 grains weight, grains weight per plant, grain yield per hectare and harvest index (HI).
The grain yield was evaluated using the following formula:

$$\text{Grain yield ha}^{-1} = \frac{\text{Yield of net plot (kg)}}{\text{Harvested area per net plot (m}^2\text{)}} * 10000\ \text{m}^2$$

The harvest index (HI) was calculated as the ratio of the grain weight to the above ground dry matter including the grain and the straw weights.

$$\text{HI} = \frac{\text{Grain yield (kg } ha^{-1}\text{)}}{\text{(Biomass + Grain yields) (kg ha}^{-1}\text{)}}$$

2.6 Data analysis

Data collected were subjected to an analysis of variance using JMP Pro 16 software. Significant treatments means were separated using Student Newman Keuls' test. The Excel spreadsheet was used for graphics construction.

3. RESULTS

3.1 Effects of *Zaï*pitdepth and cowpea variety on cowpea morphologicaltraits

The effects of *Zaï*depth and variety on morphological traits were presented in Table 1.

Plant height

*Zaï*pitdepth as well as variety had significant effect on plant height at both locations. 25 cm *Zaï*depth showed the tallest plant, while the control (tillage) exhibited the shortest. At both locations, KVx396-4-5-2D presented the tallest plant compared to the other varieties.

Number of branches per plant

*Zaï*depth significantly affected the number of branches per plant only at Kamboinsin. 15 cm *Zaï*depth resulted inhigher number of branches per plant than the other *Zaï*levels.

Cowpea varietieshad significantinfluenceon number of branches per plant at both locations. Moussa local significantly and consistently exhibitedgreaternumber of branches per plant, while Tiligreshowed the least.

Above ground biomass

At both locations, *Zaï*depthand variety significantly affected plant above ground biomass. At both sites, 25 cm *Zaï*depth consistently resulted in higher above ground biomass than the control and 15 cm *Zaï*depth. At Kamboinsin, the variety Moussa local significantly presentedthe highest above ground biomass, while Gorom local registered the lowest. At Kouare, Gorom local consistently registered the lowest above ground biomass, while the highest mean value was supported by Tiligre.

Leaf chlorophyll content

*Zaï*depth had significant influence on leaf chlorophyll content at both locations. 15 cm *Zaï*depth consistently resulted in higher leaf chlorophyll content, while the control (tillage) resulted in the lowest.

Non-significanteffect of variety onleaf chlorophyll content was observed at Kamboinsin. However, at Kouare, significant effect was registered. KVx396-4-5-2D showed the highest average value of leaf chlorophyll content, while Moussa local exhibited the lowest.

Pod length

*Zaï*depth and variety significantlyaffectedpod length.At both locations, pod length significantly increased with increasing *Zaï*depth. Longer pods were registered from 25 cm *Zaï*depth and shorter pods in the tilled plots (the control).

At varieties scale, KVx396-4-5-2D significantly presented longer pods, while Moussa local exhibited the shortest at both experimental locations.

3.2 Effects of *Zaï*pit depth on yield components and yield

At both experimental locations, the analysis of variance revealed a significant difference between *Zaï*pit depths for all the yield components and yield, except for the number of grains per pod (Table 2). Number of pods per plant, pods weight per plant, hundred grain weight, grains weight per plant and grain yield per hectare increased with increasing *Zaï*depth. At both locations, the highest number of pods per plant, pods weight per plant, hundred grains weight and grain weight per plant were recorded from 25 cm *Zaï*depth. 15 cm *Zaï*depth exhibited intermediate average values, while the control (tillage) supported the lowest.

As regards to the number of grains per pod, the statistical analysis showed a significant difference between *Zaï*treatments only at Kamboinsin. Although the highest number of grains per pod was consistently registered in 25 cm *Zaï*depth, in opposite to most of the yield characters, 15 cm *Zaï*depth resulted in the least.

At both locations, 25 cm *Zaï*depth consistently resulted in the highest grain yield per hectare (Table 2). Intermediate mean values of grain yield were consistently recorded from the 15 cm *Zaï*depth, while the lowest were registered in the control (tillage). The effect of *Zaï*depth on harvest index was significant only at Kamboinsin. 25 cm *Zaï*depth significantly supported the highest harvest index (0.50), while the control showed the least (0.41).

3.3 Effects of cowpea variety on yield components and yield

At both experimental sites, significant difference between the varieties were observed for all the yield components, grain yield and harvest index (Table 2). The variety KVx396-4-5-2D gave the highest number of pods per plant, pod weight per plant, grain yield per hectare and harvest index at both locations, while Moussa local supported the least. Gorom local and Tiligre presented intermediate average values.

For the variable number of grains per pod, the statistical analysis significantly discriminated the varieties only at Kamboinsin, where KVx396-4-5-2D presented the highest number of grains per pod (9.22) and Tiligre the lowest (6.66).

The highest hundred grains weight was constantly exhibited by Tiligre, while Moussa local registered the lowest.

Table 1. Effects of *Zaï*depth and cowpea variety on growth parameters at Kamboinsin and Kouare, averaged from two season

Treatments	PH		NBP		AGB		LCC		PL	
	Kam	Kou	Kam	Kou	Kam	Kou	Kam	Kou	Kam	Kou
*ZAÏ*DEPH (ZD) (cm)										
Tillage	101.73c	96.69c	5.93	5.02	41.84b	44.99b	39.71c	66.34b	11.45c	11.97b
15	111.67b	111.86b	6.29	5.09	46.22ab	43.68b	44.94b	70.45a	12.88b	12.59a
25	141.43a	120.87a	5.98	5.23	48.46a	50 .82a	51.68a	72.70a	13.51a	12.94a
P-value	‹.0001	‹.0001	0.07	0.30	0.040	0.0002	‹.0001	‹.0001	‹.0001	‹.0001
SE±	3.214	2.761	0.120	0.097	1.857	2.527	0.871	0.994	0.139	0.129
VARIETY (V)										
Gorom local	92.89d	111.74b	5.85b	5.22b	38.76c	34.15c	44.42	68.78b	11.64b	11.87b
Moussa local	124.04b	80.40c	7.88a	5.70a	53.77a	50.68a	45.74	66.19c	11.60b	11.67b
KVx396-4-5-2D	144.50a	132.88a	5.62b	4.42c	44.88b	41.71bc	45.68	72.75a	13.64a	13.36a
Tiligre	111.68c	114.20b	4.90c	5.12a	44.62bc	51.70a	45.94	63.61b	13.57a	13.10a
P-value	‹.0001	‹.0001	‹.0001	‹.0001	‹.0001	0.0001	0.60	0.008	‹.0001	‹.0001
SE±	3.712	3.188	0.138	0.112	2.145	2.918	1.006	1.148	0.161	0.149
Interaction										
ZD*V	‹.0001	0.046	0.37	0.78	‹.0001	0.65	0.78	0.49	0.161	0.149

PH: Plant height; NBP: Number of branches per plant; AGB: Above ground biomass; LCC: Leaf chlorophyll content; PL: Pod length; ZD: *Zaï*depth; V: Variety; SE±: Standard error; Kam: Kamboinsin; Kou: Kouare.

Table 2.Effects of *Zaï*depth and cowpea variety on yield components and yieldat Kamboinsin and Kouare, averaged from two seasons

Treatments	NPP		WPP		NGP		GWP		100GW		GYH		HI	
	Kam	Kou	Kam	Kou	Kam	Kou	Kam	Kou	Kam	Kou	Kam	Kou	Kam	Kou
*ZAÏ*DEPTH (ZD) (cm)														
Tillage	18.37c	23.30b	34.39c	41.17c	7.40c	7.53	24.77c	28.81c	19.58b	19.60b	1273.95c	1052.70c	0.41c	0.39
15	23.73b	26.46a	52.38b	53.38b	7.46b	7.63	36.52b	37.37b	20.06ab	20.35a	2282.95b	1935.78b	0.44b	0.40
25	30.22a	28.37a	71.92a	60.22a	8.01a	7.90	50.34a	42.15a	20.27a	20.55a	3146.78a	2234.97a	0.50a	0.40
P-value	‹.0001	‹.0001	‹.0001	‹.0001	‹.0001	0.52	‹.0001	‹.0001	0.022	0.004	‹.0001	‹.0001	‹.0001	0.40
SE±	0.992	0.729	2.864	1.918	0.146	0.188	2.010	1.343	0.178	0.213	123.511	79.368	0.012	0.014
VARIETY (V)														
Gorom local	24.90b	25.44b	58.31b	55.97a	7.53b	7.72ab	41.62b	39.18a	21.16b	21.22b	2493.55b	1793.46a	0.51b	0.46a
Moussa local	18.35d	22.03c	32.17d	38.58b	6.72c	7.31b	22.52d	26.87b	18.18c	18.24c	1314.39d	1164.76c	0.30d	0.33d
KVx396-4-5-2D	31.48a	28.48a	77.93a	58.58a	9.22a	8.16a	54.55a	41.01a	18.43c	18.63c	3288.24a	2082.30a	0.55a	0.49a
Tiligre	21.70c	24.09bc	44.73c	53.40a	6.66c	7.70ab	31.16c	37.38a	22.10a	22.58a	1842.05c	1724.07b	0.44c	0.43c
P-value	‹.0001	‹.0001	‹.0001	‹.0001	‹.0001	0.05	‹.0001	‹.0001	‹.0001	‹.0001	‹.0001	‹.0001	‹.0001	‹.0001
SE±	1.145	0.842	3.307	2.215	0.169	0.217	2.321	1.550	0.206	0.246	142.618	91.646	0.014	0.016
Interaction														
ZD*V	0.026	0.004	‹.0001	0.033	0.50	0.21	0.006	0.033	‹.0001	‹.0001	0.004	0.008	0.004	0.09

NPP: Number of pods per plant; WPP: Weight of pods per plant; NGP: Number of grains per pod; GWP: Grains weight per plant; GYH: Grain yield per hectare; HI: Harvest index; ZD: *Zaï*depth; V: Variety; SE±: Standard error; Kam: Kamboinsin; Kou: Kouare.

3.4 Interaction between *Zaï*pit depth and cowpea variety onmorphologicaltraits, yield components and yield

The interaction between *Zaï*depth and cowpea variety had significant impact on plant height, grain weight per plantat both locations, on above ground biomass at Kamboinsin(Table 3) as well as on grain yield per hectare at both experimental locations (Figure 1 and 2).

At both sites, all the varieties presented taller plants in 25 cm *Zaï*depth except for Tiligre at Kouare. The shortest plantwas observed in the control for 75% of the varieties at both locations.

At Kamboinsin, plant above ground biomass of all the varieties significantly differed with change in *Zaï*depth. Moussa local showed higher biomass at 25 cm *Zaï*depth and lower biomass in the control (tillage). Similar trend was observed for the other varieties except for Tiligre that exhibited higher biomass in 15 cm *Zaï*depth.

At both locations, grains weight per plant of all the varieties increased with increasing *Zaï*pit depth. Higher grains weight per plant was registered from 25 cm *Zaï*depth, while lowergrains weight per plant was registered from the control (tillage).

Hundred per cent (100%) of the varieties registered the highest grain yield in 25 cm *Zaï*depth at Kamboinsin. Similar results were observed at Kouare; except for Moussa local that showed the highest grain yield in 15 cm *Zaï*depth. However, for all the varieties, the lowest grain yield per hectare was consistently recorded from the control (tillage).

Table 3. Interaction between *Zaï*depth and cowpea variety on plant height, grain weight per plant at Kamboinsin and Kouare and above ground biomass at Kamboinsin

Variables	Varieties	Kamboinsin			Kouare		
		*Zaï*depth (cm)					
		Tillage	15	25	Tillage	15	25
Plant height	Gorom local	81.98lm	81.24lm	115.48f-i	105.44h-k	102.55ijk	126.69ef
	Moussa local	93.47jkl	107.83h-k	170.81a	69.77m	79.16lm	92.27kl
	KVx396-4-5-2D	129.11def	144.67bcd	159.72ab	109.61g-j	135.33cde	151.88bc
	Tiligre	102.36ijk	112.96f-i	119.73e-h	101.94ijk	125.47efg	124.71efg
	SE±		5.233			4.985	
Grain weight per plant	Gorom local	24.22^{jkl}	46.84^{bcd}	50.81^{bc}	33.25^{f-j}	40.71^{d-g}	43.57^{cde}
	Moussa local	16.35^{l}	19.99^{kl}	31.21^{g-j}	20.63^{kl}	31.23^{g-j}	28.81^{ijk}
	KVx396-4-5-2D	34.47^{e-i}	53.22^{b}	75.96^{a}	30.69^{hij}	38.53^{d-h}	53.80^{b}
	Tiligre	24.04^{jkl}	26.49^{ijk}	43.39^{cde}	30.68^{hij}	39.01^{d-h}	42.44^{c-f}
	SE±		4.777			2.813	
Above	Gorom	30.93gh	32.84fgh	51.51bc			

ground biomass	local			
	Moussa local	46.03b-e	51.90bc	62.37a
	KVx396-4-5-2D	43.21cde	43.45cde	46.97b-e
	Tiligre	45.86b-e	55.37ab	31.63fgh
	SE±		3.416	

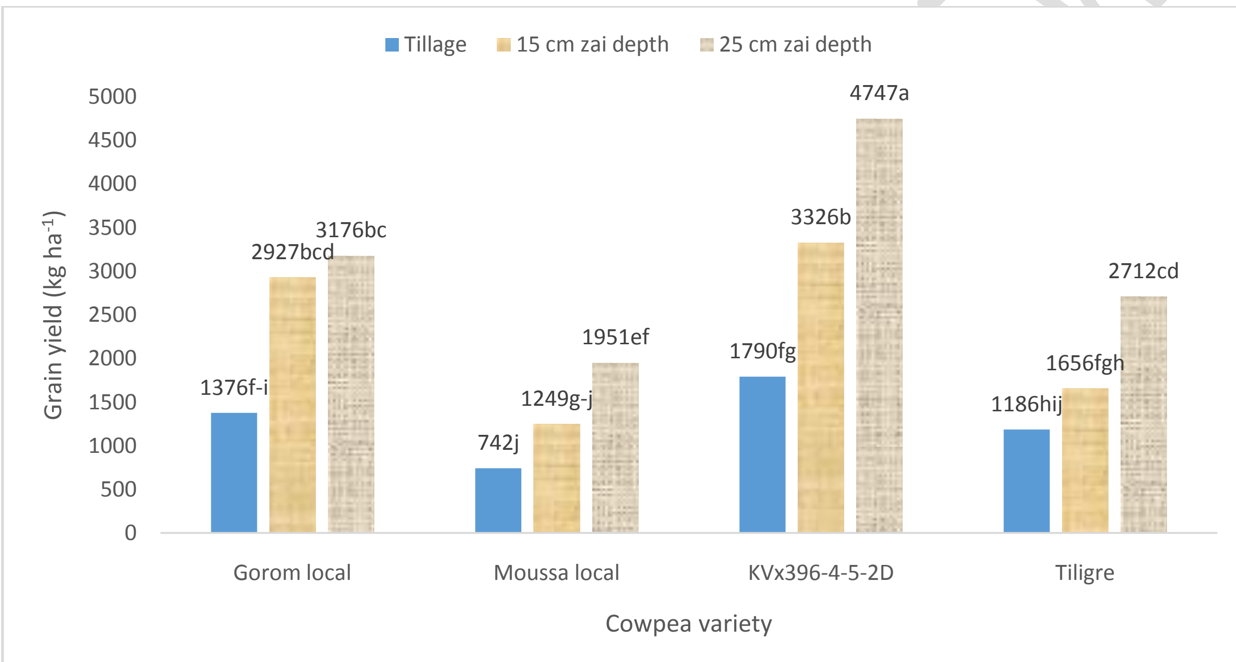

Figure 1. Interaction between *Zaï*depth and cowpea variety on grain yield per hectare at Kamboinsin

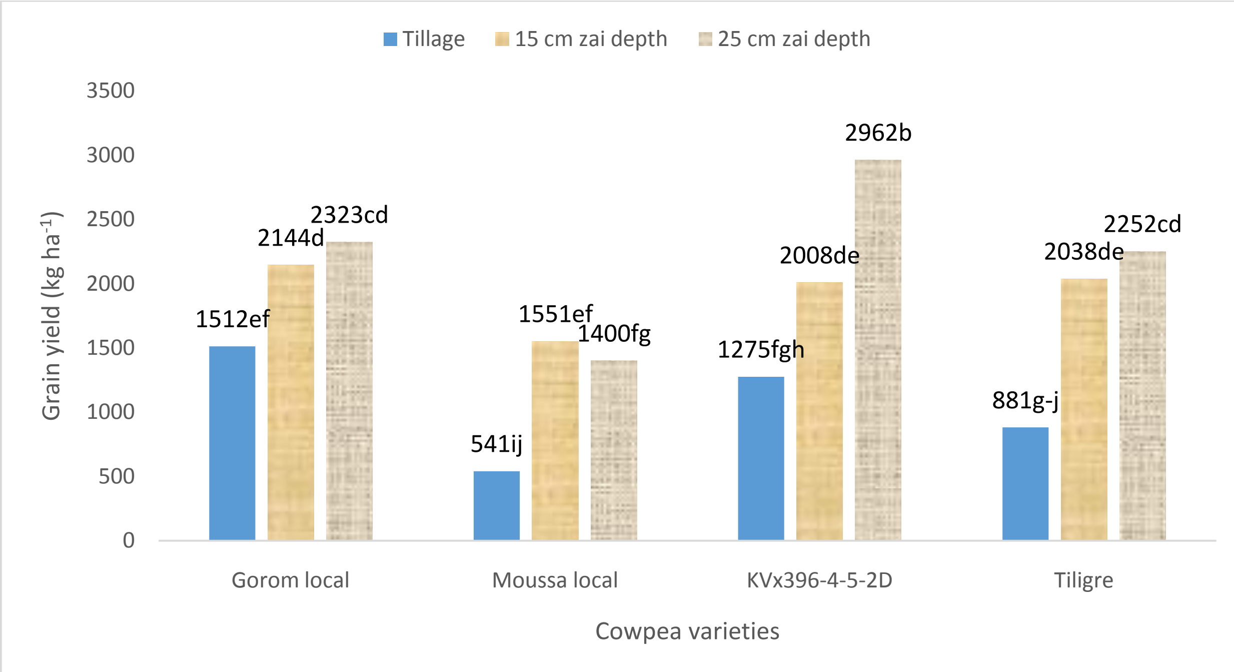

Figure 2. Interaction between *Zaï*depth and cowpea variety on grain yield per hectare at Kouare

4. DISCUSSION

4.1 Effects of *Zaï*pitdepth onmorphologicaltraits, yield components and yield of cowpea

The analysis of the variance showed a significant difference between *Zaï*depths for most of the morphological traits, yield components and yield at both experimental locations. *Zaï*of 25 cm depth presented the tallest plants and resulted in the highest above ground biomass, pod length, number of pods per plant, pods weight per plant, number of grains per pod, hundred grains weight, grains weight per plant and grain yield per hectare. Intermediate average values were recorded from 15 cm *Zaï*depth, while the lowest, at both locations, were registeredfrom the control, (tillage). This ascertainment suggests that the use of *Zaï*system as well as the *Zaï*pit depth enhanced cowpea varieties performance. The bowls formed by *Zaï*pits increased nutrients and water availability for plantsfor their optimum growth leading to a good productivity comparatively to the flat soil (tillage), in which,nutrients and water at the soil surface are more susceptible to transport outside plant growing area under erosion effects. In effect, the *Zaï*pits allow nutrients accumulation and water collection at the plant rooting zone necessary to a good pod formation and filling (Lenhardt *et al*., 2014; Schuler *et al*., 2016). This explains the increase of the average values of the plant tall, above ground biomass, pod length, number of pods per plant, pods weight per plant, number of grains per pod, hundred grains weight, grains weight per plant and grain yield per hectare in the 25 cm *Zaï*depth, followed by that of 15 cm depth and their decrease in the control (tillage). These advantages of *Zaï*technique use in crop production compared with the tillage have been underlined by several authors. According to Jägermeyr *et al*.(2016), integrating water harvesting technologies such as *Zaï*system with soil fertility management techniques can create synergies that can further increase water use efficiency and hence, the final yield. Sawadogo (2017)suggested that *Zaï*system increases respectively by 4- and 2-times red sorghum and pearl millet yield comparatively to the control. The obtained results also corroborate those of Roose *et al*. (1994), that resulted from a study conducted at Donsin village in Burkina Faso where much cropping-lands are deteriorated, that *Zaï*substantially increases average yields with values ranging between 1200 kg/ha to 4 t/ha. Wildemeersch *et al*. (2015)reported that *Zaï*practice not only increases production of cereals grains (150 to 1700 kg/ha) and straw (500 to 5300 kg/ha) but also reintroduces a large diversity of useful plants that may help during the fallow period and the process of degraded soils restoration. In this study, in both experimental sites, 25 and 15 cm *Zaï*depths respectively allowed an increase in cowpea grain yield of more than 87% and 50% compared to the control, the tilled soil. This not only testifies the *Zaï*impact in improving cowpea yield but also the importance of varying the *Zaï*depth for obtaining better yield. 25 cm *Zaï*depth collects and stocks more efficiently water and nutrients near plant root system, ensuring a better development of plants compared to 15 cm *Zaï*depth. Thus, the deeper the *Zaï*depth, the higher the grain yield. The substantial increase in grain yield is in line with Malesu *et al*. (2006)that reported that *Zaï*practice has the potential to increase cereal yields by a factor 10, and yields increase further with the application of organic amendments. World Bank (2005) suggested that the application of *Zaï*technique can increase production by about 500% if well executed. The highest average grain yield having been registered from 25 cm *Zaï*depth, this means that at both locations, Kamboinsin and Kouare, with the same thickness of 30 cm, 25 cm *Zaï*depth would be more suitable for cowpea production than that of 15 cm depth and the tillage that resulted in the lowest grain yield. However, the increase of grain yield with the *Zaï*pit depth could be site-specific and dependent on the soil chemical and physical properties, which need to be taken into account according to the agro ecological zone of production. The low fertility or the encrusted nature of some soils at deeper horizons can negatively affect the efficiency of the*Zaï*depth in increasing the yield.

4.2 Interaction between*Zaï*pitdepth and cowpea variety on yield

The interaction between *Zaï*treatments and cowpea varieties had significant effects on grain yield. Seventy-five (75%) of the varieties showed the highest grain yield in 25 cm *Zaï*depth at both locations; except Moussa local that exhibited the highest grain yield in 15 cm *Zaï*depthat Kouare. However, without exception,the lowest grain yield per hectare was recorded from the control (tillage). Similarly, the tallest plantfor all the studied varieties wasrecorded from 25 cm *Zaï*depth, whereas the shortest was registered from the tillage (control). The same trend was observed for the variables grain weight per plant at both locations and for above ground biomass at Kamboinsin. These results show the importance of *Zaï*pits positive impact in enhancing cowpeavarieties agronomical performance. *Zaï*system use for cowpea cultivation enables plants to produce more and effective pods and subsequently increases the grain yield, comparatively to sowing in flat soil. This great performance under *Zaï*,presented by all the varieties involvedin this study could be attributed to the ability of *Zaï*pits in collecting rain or irrigation water and nutrients near plants rooting zone. The concentration of water and nutrients thanks to the bowls formed by the pits positively affects plants growth and therefore their final yield. The resultsare in line with findings ofJägermeyr *et al.*(2016) and World Bank (2005), who suggested that agricultural practices such as *Zaï*system have ability to substantially increasing crops yield. The gap in grain yield observed between 25 cm and 15 cm *Zaï*depth at both experimental locations shows that the use of bowls of 25 cm depth for cowpea production is more advantageous in reinforcing cowpea varieties productionpotentialities compared to that of 15 cm depth. The exceptional high grain yield observed in 15 cm *Zaï*depth at Kouare for the variety Moussa local compared to the others, could be explained by intrinsic characteristics to this variety or by plants diseases which were not noted in this study.The *Zaï*of 25 cm depth can therefore be advised to be used by cowpea growers for getting higher yield instead of using pits of 15 cm or tillage that substantially leads to lower grain yield.

5. CONCLUSION

The *Zaï*depth variation has significant positive impact on cowpea production. 25 cm and 15 cm*Zaï* depth substantially increase cowpea agronomicalperformance. The deeper the *Zaï*, the higher the yield attributes average values and yield.Comparatively to the control, the tilled soil, sowing in 25 cm and 15 cm*Zaï* depth can increase cowpea grain yield of more than 87% and 50% respectively.KVx396-4-5-2D and Moussa local are respectively the high and the low grain yieldingvarieties. Cowpea varieties differently interact with the *Zaï*treatments. 25 cm *Zaï*depth result in higher grain yield in cowpea production, while sowing in tilled soil results in lower yield.. Even though, the physical and chemical properties of the soil are to be considered, this study carried out in two locations shows that 25 cm*Zaï*depth appears the most advantageous agricultural practice in cowpea production rather thanto that of 15 cm depth. Sowing cowpea in tilled soil giveslowergrain yield compared to using *Zaï*technique.

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