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RESEARCH ARTICLE

AGRONOMIC PERFORMANCE OF COWPEA [VIGNAUNGUICULATA(L.) WALP.] VARIETIES AS INFLUENCED BY COMBINED APPLICATION OF POULTRY MANURE AND MINERAL FERTILIZER IN TWO AGRO-ECOLOGICAL ZONES OF BURKINA FASO

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Abstract

Field experiment was laid in a split plot design in 2019 and 2020 at rainy seasons at Farako-Ba in soudanian and Kamboinse in soudano-sahelian agro-ecological zones of Burkina Faso. The fertilizer levels (0 kg/ha, 100 kg/ha NPK as control, 60 kg/ha NPK + 1.5 t/ha poultry manure, 100 kg/ha NPK + 1.5 t/ha poultry manure and 75 kg/ha TSP (P205) + 1.5 t/ha poultry manure) occupied the main plots while the cowpea varieties (KVx745-11P, Komcalle, Tiligre and Neerwaya) were assigned to the sub-plots. The results of the study showed that location as well as fertilizer application rate have significantly affected most of agronomic characters. The average yield recorded in Farako-Ba were 1013.79 kg/ha and 1030.51 kg/ha for 2019 and 2020 while in Kamboinse it was 1166.59 kg/ha and 1165.03 kg/ha, in 2019 and 2020, respectively. The highest grain yield was recorded with combined application of poultry manure with mineral fertilizer at 100 kg/ha NPK + 1.5 t/ha poultry manure. This was followed by 75 kg/ha TSP (P205) + 1.5 t/ha poultry manure. The results suggest that combined application of poultry manure and chemical fertilizer can restore soils and lead to high yields in cowpea.

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Introduction:-

Cowpea (*Vigna unguiculata* (L.) Walp.) is one of the most important and widely cultivated legumes in the world, particularly in Africa, Latin America and some parts of Asia and the United States (Xiong et al., 2016). Cowpea is cultivated for its leaves, green pods, fodder and mature pods. Traditionally, in West Africa, it is intercropped with other food crops. Increasingly, with developing of seeds companies, cowpea is cropped in sole. In Africa, particularly in western region where cowpea production is important and widespread, the lowest yields have been observed among rural poor farmers. Ehlers and Hall (1997) have reported that average cowpea yield in Africa was less than 300 kg ha⁻¹. Various reasons such as traditional cultivation systems, low soil fertility, inadequate planting systems, inappropriate cultivars and existing planting practices limit cowpea yield in Africa (Ajeigbe et al., 2010;

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Kamara et al., 2018). In Burkina Faso, agriculture is characterized by a low productivity due to natural poor soils in mineral elements (nitrogen, potassium and phosphorus) and continuous decline in soil fertility through practice of extensive and mining farming (SNGIFS, 2015). According to the estimation of Ministry of Agriculture (1999), Burkina Faso soils contains less than 1% of organic matter, less than 0.06% of nitrogen and less than 0.06% of phosphorus. Fallow land which was the traditional way of soil fertility enhancement is less practiced because of high demand of arable soils (Bado, 2002). The rapid demographic growth is putting pressure on agricultural lands which become under permanent cultivation. Add to the fact that soils in semiarid West Africa are inherently low in nitrogen and phosphorus, soils productivity tends to decline and even fertilizer resilient crops like cowpea yields are declining despite breeding efforts to release high-performing varieties. Application of poultry manure prior to sowing combined with mineral fertilizer at seedling emergence and use of improved cowpea germplasm may increase agronomic efficiency and restore soil fertility.

Materials and Methods:-

The study was carried out during rainy seasons (July-October) of two consecutive years (2019 and 2020) in two agro-ecological zones (AEZ) of Burkina Faso. At Kamboinse Research Station (12°27' N 1°32' W; 295 m) and Farako-Ba Research Station (11°5' N 4°18' W; 439 m). The experiment comprised of 4 cowpea varieties (KVx745-11P (dual-purpose variety), Komcalle (KVx442-3-25SH), Tiligre (KVx775-33-2G) and Neerwaya (KVx780-6). and 5 fertilizer levels (0 kg/ha, 100 kg/ha NPK as control, 60 kg/ha NPK + 1.5 t/ha poultrymanure, 100 kg/ha NPK + 1.5 t/ha poultry manure and 75 kg/ha TSP (P_2O_5) + 1.5 t/ha poultry manure). These were laid out in a Split Plot Design (SPD) with three replications. Fertilizer levels were assigned to the main plots while the sub-plots were occupied by cowpea varieties. Poultry manure (PM) at a rate of 1.5 tons per hectare was incorporated to the soil at two weeks before sowing. Compound NPK (14-23-14) and TSP (46 % P_2O_5) fertilizer was applied by micro-dose at two weeks from sowing date.

The fertilizer levels were: 0, 100 kg/ha NPK, 60 kg/ha NPK + 1.5 t/ha PM, 100 kg/ha NPK + 1.5 t/ha PM and 75 kg/ha TSP + 1.5 t/ha PM. The number of rows per sub plot was six (6) and data were collected from the net plots made up of two innermost rows of each sub plot. The two rows on either side of innermost rows were considered as a sampling rows. Cowpea varieties were sown at plant spacing of 70 cm x 30 cm, corresponding to a plants population of 95,238 per hectare. The size of each main plot was 40.8 m². Sub plot measure was 8.4 m² while each net plot size was 3.36 m². A distance of 1 m was left between sub plots while the main plots and replications were separated by 1.5 m. Prior to sowing, land was cleared, harrowed and leveled. seeds were treated with a combination of chlorpyrifos-ethyl and thiram (Calsio) an insecticide-fungicide at a rate of 20 g per kg⁻¹ of seeds. Weeds were controlled manually by hoe weeding at 3 and 6 weeks after sowing. At 8 weeks after sowing, weeds were uprooted manually. Pesticide application was done at 5 and 7 weeks after sowing by using Deltamethrinat the dose of 1 litre/ha

Six plants from the middle two rows were randomly selected and tagged, on which growth parameters were collected at 6 and/or 9 weeks after sowing (WAS). Data on plants height at 6WAS and 9 WAS, branches number were taken at 9 WAS. The average number of leaves, shoots dry weight and leaves chlorophyll content were recorded at 6 WAS. Data on reproductive traits and grain yield components such as: day to 50% flowering, day to 95% pods maturity, pods length, number of seeds per pod, 100 seeds weight as well as shelling percentage, fodders yield and grains yield were estimated or/and computed from data collected in each two innermost rows. Data collected were subjected to analysis of variance (ANOVA) done by using JMP Pro 2017 statistical package, while Student Newman's Keuls (SNK) test was used to sort out significant treatment means ($P \leq 0.05$).

Results and Discussion: -

Table 1 shows that soil texture class was sandy-loam at Farako-Ba and loamy at Kamboinse. Chemical properties of soils in both locations were similar. The pH values were 6.59 and 6.13 for Farako-Ba and Kamboinse respectively. Soils in experimental sites were poor in organic carbon and total nitrogen. An organic amendment could improve their physical and chemical status. Poultry manure used as background fertilizer pH was little bit acidic (5.61). According to (Agbede et al., 2008), soil physical and chemical properties is improved when poultry manure is added to the nutrients subtract.

Table 1 : Physical and Chemical Property of Soils at Farako-Ba and Kamboinse and Poultry Manure chemical

Soil Physical Properties	Farako-Ba	Kamboinse	Chemical Properties	Farako-Ba	Kamboinse	Poultry Manure
Sand	63.37	46.75	pH	6.59	6.13	5.61
Silt	21.18	40.54	Organic C (%)	0.50	0.64	13.27
Clay	15.45	12.71	Total N (%)	0.047	0.051	0.66
Texture Class	Sandy-Loam	Loamy	Available P (mg/Kg)	4.89	3.45	4.75
			Ex.cations (cmol⁺/Kg)			
			K	0.15	0.13	1.13
			Na	0.10	0.06	0.12
			Ca	1.40	1.55	2.05
			Mg	0.43	0.60	0.81
			EA (cmol ⁺ /Kg)	0.02	0.09	0.16
			CEC (cmol ⁺ /Kg)	2.09	2.43	3.11

Source: Soil Lab, Centre for Dryland Agriculture, Bayero University, Kano

Meteorological data were recorded from experimental sites. The average rainfall values were 1370.20 mm and 1131.50 mm for Farako-Ba in 2019 and 2020 respectively. At Kamboinse, the values were 932.30 mm and 912.50 mm for 2019 and 2020 respectively. The average minimum and maximum temperature was (22.32°C and 33.81°C) and (22.38°C and 34.07°C) for Farako-Ba in 2019 and 2020 respectively. The average values recorded at Kamboinse were (23.20°C and 35.72°C) and (23.21°C and 35.93°C) for 2019 and 2020 respectively. Over the two years, as expected, the annual rainfall was higher in Farako-Ba than Kamboinse. Also, average temperatures were slightly lower in Farako-Ba than Kamboinse. Temperature and rainfall might significantly affect cowpea production. According (Khan et al., 2010) and (Mohammed et al., 2021) too more rainfall inhibit good performance of cowpea yield while positive relationship exists between temperature and cowpea yield.

The results of plants height at six and nine weeks after sowing according to cropping year, fertilizer rate and cowpea varieties at Farako-Ba and Kamboinse are presented in Table 2. At 6 WAS, the effect of cropping year was not significant, however contrasted effect was found with fertilizer application concerning both locations. At 9 WAS, fertilizer effect was not significant on plants height even if positive trends were found with combined application of mineral and organic fertilizer. This result is in concordance with findings of Abayomi et al., (2008) who reported that lowest plants height were recorded in plots with no application of fertilizer. Also, Karikari et al., (2015) showed that fertilizer rate, particularly P fertilizer affects significantly plant height. The average plants height show that varieties have different growth capacities. These results were consistent with Karikari and Arkorful, (2015) and El-Naim & Jabereldar, (2010) who reported that differences in plants height could be explained by genetic effect of individual varieties. Also, similarly, Bisikwa et al., (2014) showed that there was significant difference in plants height among cowpea varieties.

The average number of leaves per plant at 6 WAS presented in Table 3 shows significant difference as result of fertilizer application rate. Also, it is noticed that cowpea varieties as well as growing environment has significantly impacted the average number of leaves per plant. Fatahi et al., (2014) demonstrated that manure application has significant effect on number of leaves. Tiligre and Neerwaya which were prostrate recorded the highest leaves followed by KVx745-11P while Komcalle recorded lowest leaves number. This may be due to genetic constitution of varieties. This result is in conformity with the investigation of earlier workers who observed significant difference in number of leaves per plant among different cowpea varieties Agyeman et al., (2014) ; Miheretu & Sarkodie-Addo, (2017).

In Table 3, it is noticed that average branches number per plant was not statistically different for cropping year and for different fertilizers application rate excepted at Farako-Ba at 9 WAS where fertilizer application induced significant difference. The control plot (0 kg/ha) recorded the lowest average branches number. The relative high number of primary branches could be explained by the fact that adequate nutrients were available for optimum growing of cowpea plants. This result is in agreement with investigations of Olusegun, (2014) and Miheretu &

Sarkodie-addo, (2017) who found that combined application of organic manure and inorganic nitrogen fertilizer increase average number of branches of cowpea as compared to sole application of mineral fertilizer or no fertilizer application. This trait shows significant differences between varieties. Tiligre and Neerwaya produced higher average number of branches per plants and KVx745-11P produced lower. This variation might be due to the differences in genetic composition among the cowpea varieties. Agyeman et al., (2014) and Miheretu & Sarkodie-Addo (2017) reported significant differences in average number of branches per plant among different cowpea varieties.

Table 2 : Cropping Year, Fertilizer Levels and Varietal Effects on Plant Height, at 6 and 9 WAS at Farako-Ba and Kamboinse

	Plants height (cm) 6WAS		Plants height (cm) 9WAS	
	Farako-Ba	Kamboinse	Farako-Ba	Kamboinse
Cropping Year				
2019	36.72	42.56	54.08a	52.83b
2020	33.81	43.60	40.95b	61.63a
Prob.	0.2607	0.6513	0.0001	0.0018
SE±	1.82	1.62	2.33	1.94
Fertilizer levels				
0	26.42c	38.21	43.59	55.46
100 NPK	33.08bc	46.46	41.97	55.72
60 NPK + PM	35.28ab	43.85	47.86	61.15
75 TSP +PM	42.94a	45.57	50.95	54.36
100 NPK + PM	38.63ab	41.29	53.21	59.47
Prob.	0.0017	0.1514	0.1642	0.4653
SE±	2.88	2.56	3.69	3.07
Varieties				
KVx745-11P	38.79a	45.62b	56.57a	55.61b
Komcalle	14.04b	16.03c	15.89b	16.93c
Tiligre	43.42a	56.31a	58.84a	79.11a
Neerwaya	44.83a	54.34a	58.7a	77.27a
Prob.	<.0001	<.0001	<.0001	<.0001
SE±	2.58	2.29	3.30	2.75

Means followed by the same letter (s) within a treatment group are not significantly different at 5% level of probability using Student Newman Keuls (SNK) test

	Leaves chlorophyll 6WAS		Shoots dry weight (g) 6WAS	
	Farako-Ba	Kamboinse	Farako-Ba	Kamboinse
Cropping Year				
2019	53.67	55.05a	26.94	33.06
2020	52.96	53.30b	27.74	29.65
Prob.	0.2599	0.0077	0.7047	0.0506
SE±	0.44	0.46	1.48	1.22
Fertilizer levels				
0	54.30	54.41	18.01b	28.01b
100 NPK	51.65	54.28	28.97a	30.47b
60 NPK + PM	53.50	54.22	27.89a	30.14b
75 TSP +PM	53.55	53.51	29.55a	31.1b
100 NPK + PM	53.59	54.45	32.27a	37.06a
Prob.	0.0943	0.8896	0.0005	0.0185
SE±	0.69	0.72	2.35	1.93
Varieties				
KVx745-11P	51.77b	53.74ab	27.07	29.59b
Komcalle	53.14ab	52.83b	24.14	27.81ab
Tiligre	53.49ab	54.76a	28.40	34.06a
Neerwaya	54.87a	55.3a	29.74	33.96a
Prob.	0.0072	0.0348	0.2783	0.0220
SE±	0.62	0.65	2.10	1.73

Table 3: Cropping Year, Fertilizer Levels and Varietal Effects on Plant Leaves number (6 WAS) and Branches number (9 WAS) at Farako-Ba and Kamboinse

Means followed by the same letter (s) within a treatment group are not significantly different at 5% level of probability using Student Newman Keuls (SNK) test. Table 4 shows that there is no variation of leaves chlorophyll content according to fertilizer application. This result is opposite to the findings of El-Warakly (2007) who showed that cowpea leaves chlorophyll content is positively impacted by nitrogen fertilizer. The differences in leaves chlorophyll content according to varieties could express their differences in term of photosynthetic capacity. This result is supported by Dong et al., (2019) who found that cowpea genotypes are inherently different in chlorophyll content. Also, the results demonstrated that growing environment may have significant influence on leaves chlorophyll content. At the stage of 6 WAS, the results of shoots dry weight were statistically similar within the location across the years (Table 4). The results showed that the average shoots weight according to cowpeas varieties was not significant at Farako-Ba while in Kamboinse contrasted results were found. The effect of fertilizer was remarkable at 6 WAS which can be explained by the fact that fertilizer application accelerates plants growth, as evidenced by the increase in shoot dry weight.

Table 4: Cropping Year, Fertilizer Levels and Varietal Effects on Leaves chlorophyll content (6WAS) and Plant Shoots dry weight (6WAS) at Farako-Ba and Kamboinse

	Leaves number 6WAS		Branches number 9WAS	
	Farako-Ba	Kamboinse	Farako-Ba	Kamboinse
Cropping Year				
2019	29.19	36.51b	3.91	3.88
2020	30.75	38.74a	3.97	3.96
Prob.	0.0598	0.0318	0.6413	0.4477
SE±	0.58	0.73	0.09	0.07
Fertilizer levels				
0	26.45c	34.06b	3.61	3.81
100 NPK	28.48bc	37.98a	4.03	3.77
60 NPK + PM	30.54ab	38.85a	4.05	3.93
75 TSP + PM	32.36a	39.44a	3.94	4.03
100 NPK + PM	32.03a	37.79a	4.07	4.05
Prob.	<.0001	0.0127	0.1102	0.3146
SE±	0.92	1.15	0.14	0.11
Varieties				
KVx745-11P	29.50b	38.16a	3.46b	3.63b
Komcalle	26.21c	31.23b	4.06a	3.77b
Tiligre	32.60a	40.80a	4.20a	4.18a
Neerwaya	31.58ab	40.30a	4.04a	4.10a
Prob.	<.0001	<.0001	0.0002	0.0003
SE±	0.82	1.03	0.12	0.10

Means followed by the same letter (s) within a treatment group are not significantly different at 5% level of probability using Student Newman Keuls (SNK) test. In Table 5, it is showed that 50% flowering varied significantly according to cropping season, fertilizer rate and varietal difference in both experimental sites. The results indicated that 50% flowering cycle slightly decrease when fertilizer was applied. This result is in line with findings of Nkaa et al., (2014) who stated that enhancement of growth by P fertilizer induced earlier flowering. There was a significant difference in number of days to 50% flowering among cowpea varieties. Genetic constitution of each variety may explain the difference of phenological attributes. Similar results were obtained by authors such (El-Naim et al., 2012) and (Bisikwa et al., 2014). The results showed that cropping year as factor may significantly affect 95% maturity trait (Table 5). None significant difference was observed on this character as result of fertilizer application. Furthermore, cowpea varieties show some differences concerning their maturity cycle. This could be attributed to genetic attributes of each variety. Comparable results were found by Bisikwa et al., (2014).

	50% Flowering		95% Maturity	
	Farako-Ba	Kamboinse	Farako-Ba	Kamboinse
Cropping Year				
2019	39.52a	38.92a	65.77a	64.84a
2020	38.83b	38.00b	63.58b	62.97b
Prob.	<.0001	<.0001	<.0001	<.0001
SE±	0.10	0.10	0.15	0.14
Fertilizer levels				
0	39.71a	38.83a	64.92	64.29
100 NPK	39.25b	38.38bc	64.64	64.00
60 NPK + PM	39.04bc	38.21c	64.67	64.14
75 TSP +PM	39.13bc	38.17c	64.88	63.54
100 NPK + PM	38.75c	38.71ab	64.29	63.55
Prob.	0.0016	0.0075	0.3912	0.0636
SE±	0.16	0.16	0.24	0.23
Varieties				
KVx745-11P	39.80a	38.50b	66.81a	66.53a
Komcalle	37.93b	37.30c	61.27d	60.84b
Tiligre	39.43a	38.97a	64.50c	63.40d
Neerwaya	39.53a	39.07a	66.13b	64.84c
Prob.	<.0001	<.0001	<.0001	<.0001
SE±	0.14	0.14	0.22	0.20

Table 5: Cropping Year, Fertilizer Levels and Varietal Effects on 50% Flowering and 95% Maturity at Farako-Ba and Kamboinse

Means followed by the same letter (s) within a treatment group are not significantly different at 5% level of probability using Student Newman Keuls (SNK) test. Some contrasted variations in average pods length were noticed according to cropping year and fertilizer rate (Table 6). The effect of cropping year was not significant at Farako-Ba, which was contrary to what obtained in Kamboinse. In addition, fertilizer effect on pods length was not significant at Farako-Ba, while in Kamboinse, the effect was significant. A significant varietal effect on average pods length was recorded. KVx745-11P and Komcalle recorded similar values while Neerwaya and Tiligre recorded the highest values of average pods length. These results could be explained by genotypes differential response. This is in concordance with the findings of Ezeaku et al., (2015); but contrasted with the results of Alidu, (2019) who did not observe significant difference of pods length among three cowpea varieties. The average pods length was higher in Kamboinse when compared to Farako-Ba. Differences in growing environment could explain these results.

Cropping year, fertilizer and cowpea variety can induce significant variation of average number of seeds per pod (Table 6). In both locations, no tangible relationship was found between fertilizer application and number of seeds per pod. However, Olusegun, (2014) and Karikari et al., (2015) reported a relative increase or significant difference in number of seeds per pod with fertilizer application. In this study, the variety KVx745-11P recorded the highest mean while Komcalle, Neerwaya and Tiligre recorded more or less statistically similar average number of seeds per pod. These results were supported by (El-Naim & Jabereldar, 2010; Nwofia et al., 2014) who demonstrated that average seeds/P is a character highly correlated to cowpea variety.

	Pods length (cm)		Number seeds per pods	
	Farako-Ba	Kamboinse	Farako-Ba	Kamboinse
Cropping Year				
2019	15.59	16.07b	9.94b	10.08b
2020	15.75	16.68a	11.08a	11.32a
Prob.	0.4835	0.0018	<.0001	<.0001
SE±	0.15	0.13	0.14	0.13
Fertilizer levels				
0	15.27	16.94a	10.18b	11.12a
100 NPK	15.36	16.22bc	10.03b	10.82ab

60 NPK + PM	15.97	16.67ab		10.63ab	10.78ab
75 TSP +PM	15.88	16.14bc		10.61ab	10.28b
100 NPK + PM	15.86	15.90c		11.10a	10.49b
Prob.	0.1297	0.0047		0.0100	0.0389
SE±	0.24	0.21		0.23	0.20
Varieties					
KVx745-11P	14.10b	14.75b		11.69a	11.76a
Komcalle	13.70b	14.49b		9.63c	10.20b
Tiligre	17.70a	18.24a		10.67b	10.66b
Neerwaya	17.19a	18.01a		10.04c	10.17b
Prob.	<.0001	<.0001		<.0001	<.0001
SE±	0.22	0.19		0.20	0.18

Table 6: Cropping Year, Fertilizer Levels and Varietal Effects on 50% Flowering and 95% Maturity at Farako-Ba and Kamboinse

Means followed by the same letter (s) within a treatment group are not significantly different at 5% level of probability using Student Newman Keuls (SNK) test. For shelling percentage, the results showed that within the same location, there is no significant variation of shelling percentage resulted from fertilizer application effect (Table 7). Nevertheless, location may have significant effect on shelling percentage as its average values were lower in Farako-Ba than Kamboinse. Agroecological zone could have significant influence on pods filling. Our results were corroborated by the findings of Ezeaku et al., (2015) who showed that shelling percentage can vary significantly across seasons for the same location or between different locations regarding to climate variability. The results showed significant difference of shelling percentage between varieties grown in the same location. Previous studies conducted by Sakariyawo et al., (2017) and (Momohjimoh & Tanko, 2021) corroborate these findings.

The results show that cropping year as well as location can significantly influence 100 seeds weight (Table 7). Climatic factors characterized by rainfall and temperature variations across years and locations could explain the differences. These are consistent with the findings of Ezeaku et al., (2015) who obtained similar results after conducted research in two different environments. Fertilizer levels did not show significant variations of this character. Ndor et al., (2012) found similar results. In opposition, Singh et al., (2011) and Karikari et al., (2015) showed significant variation of 100 seeds weight in plot with no fertilizer compared to plots with different P levels. There was highly significant difference of 100 seeds weight between the four cowpea varieties which can be grouped into three. The lowest values were recorded by KVx745-11P followed by Komcalle. Neerwaya and Tiligre recorded the highest means of 100 seeds weight. The fact that this trend is maintained from one location to another and across seasons is the evidence that the character is varietal dependent. These results are supported by several research works from authors such as (Bisikwa et al., 2014; Ezeaku et al., 2015; El-Naim et al., 2012; Sakariyawo et al., 2017) who pointed out the difference between cowpea varieties according to their 100 seeds weight. This is inconsistent with the findings of (Singh et al., 2011) and (Karikari et al., 2015) who did not observe significant difference for that character between cowpea varieties.

Cowpea fodder yield did not significantly influence by cropping year (Table 8). At Farako-Ba, the average fodder yields were 4055.97 kg/ha and 4374.46 kg/ha for 2019 and 2020 respectively. At Kamboinse experimental site, fodder yields were 5270.28 kg/ha and 5408.80 kg/ha for 2019 and 2020 respectively. Fertilizer application effect was significant on cowpea fodder yield. From combined results obtained at Farako-Ba and Kamboinse, the lowest fodder yields were recorded in control plot (0 kg/ha). The positive response of fodder yield to fertilizer application could be attributed to the fact that fertilizer releases more nutrients which increase photosynthetic activity and it results more production of leaves, branches, which contribute to biomass yield. The observed results are in conformity with the findings reported by (Singh et al., 2011; Nkaa et al., 2014; Namakka et al., 2018) who demonstrated a positive effect of P fertilizer on cowpea fodder yield. In line with these authors, (Bado et al., 2006; Olusegun, 2014) found that sole application of manure or with mineral fertilizer increase significantly fodder yield. Concerning varietal influence on fodder yield, the two years' data showed that the lower yield was recorded by Komcalle while for the respective variety KVx745-11P, Neerwaya and Tiligre, fodder mean was statistically similar. The average grain yield obtained in Farako-Ba was 1013.79 kg/ha and 1030.51 kg/ha respectively for 2019 and 2020 cropping year (Table 8). The means recorded at Kamboinse were 1166.59 kg/ha and 1165.03 kg/ha for 2019 and

2020 cropping year. The values were higher in Kamboinse than Farako-Ba. The results (Table 8) showed that cowpea grains yield vary in function of fertilizer rate. At Farako-Ba, the highest GY (1242.93 kg/ha) was achieved by 100 kg/ha NPK+1.5 t/ha PM followed by the treatment 75 Kg/ha TSP+ 1.5 t/ha PM (1209.94 kg/ha).

Table 7: Cropping Year, Fertilizer Levels and Varietal Effects on Shelling percentage (%) and 100 Seeds weight (g) at Farako-Ba and Kamboinse

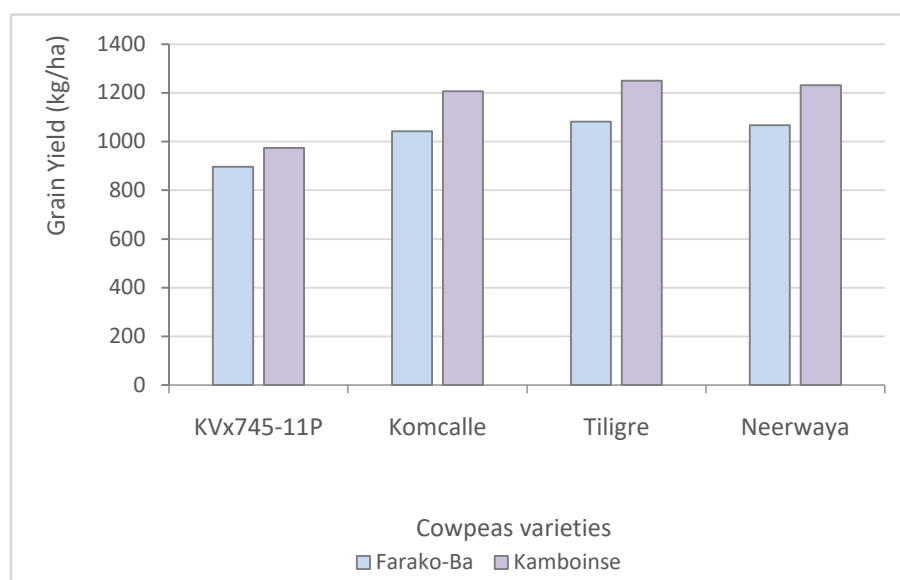
	Shelling percentage (%)		100 Seeds weight (g)	
	Farako-Ba	Kamboinse	Farako-Ba	Kamboinse
Cropping Year				
2019	66.34	75.44	14.49b	18.11a
2020	65.39	74.52	16.08a	16.09b
Prob.	0.2502	0.1065	<.0001	<.0001
SE±	0.58	0.40	0.12	0.15
Fertilizer levels				
0	65.74	74.99	15.42	17.40a
100 NPK	64.17	73.78	15.47	16.69b
60 NPK + PM	66.68	74.84	15.28	17.19ab
75 TSP +PM	65.52	75.82	15.05	17.31ab
100 NPK + PM	67.22	75.47	15.20	16.90ab
Prob.	0.1673	0.2017	0.5190	0.1652
SE±	0.91	0.63	0.19	0.23
Varieties				
KVx745-11P	66.26ab	75.05b	10.48c	11.45c
Komcalle	67.71a	77.48a	15.39b	16.74b
Tiligre	65.20b	73.96bc	17.66a	20.22a
Neerwaya	64.30b	73.43c	17.61a	19.97a
Prob.	0.0248	<.0001	<.0001	<.0001
SE±	0.82	0.56	0.17	0.21

Means followed by the same letter (s) within a treatment group are not significantly different at 5% level of probability using Student Newman Keuls (SNK) test. The control plot (0 kg/ha) recorded the lowest GY (438.19 kg/ha). At Kamboinse, the combined data results indicate that fertilizer effects were similar as Farako-Ba with a relative higher means. The highest GY was recorded with 100 kg/ha NPK+1.5 t/ha PM (1481.06 kg/ha), followed by the treatment 75 Kg/ha TSP+1.5 t/ha PM (1344.13 kg/ha). The lowest GY were recorded with 0 kg/ha (501.58 kg/ha). It can be noticed that grain yield is influenced by variety type. At Farako-Ba and Kamboinse, KVx745-11P recorded the lowest GY which respective means were 876.4 kg/ha and 930.2 kg/ha. The highest GY were recorded with cowpea variety Neerwaya. At Farako-Ba, its mean was 1081.85 kg/ha while at Kamboinse, it was 1250.76 kg/ha. The crop performs better at Kamboinse than Farako-Ba environment.

Table 8: Cropping Year, Fertilizer Levels and Varietal Effects on Fodder Yield (kg/ha) and Grains Yield (kg/ha) at Farako-Ba and Kamboinse

	Fodder Yield (kg/ha)		Grains Yield (kg/ha)	
	Farako-Ba	Kamboinse	Farako-Ba	Kamboinse
Cropping Year				
2019	4055.97	5270.28	1013.79	1166.59
2020	4374.46	5408.80	1030.51	1165.03
Prob.	0.0864	0.4844	0.1548	0.9278
SE±	130.17	139.61	8.25	12.14
Fertilizer levels				
0	2712.60d	3435.76c	438.19c	508.58d
100 NPK	4231.12bc	5402.43b	1110.81b	1237.94c
60 NPK + PM	4127.10c	5810.09b	1108.88b	1257.33c
75 TSP + PM	4764.32ab	5603.35b	1209.94a	1344.13b
100 NPK + PM	5240.94a	6446.06a	1242.93a	1481.06a
Prob.	<.0001	<.0001	<.0001	<.0001
SE±	205.82	220.74	13.05	19.20
Varieties				
KVx745-11P	4498.92a	5497.25a	896.62c	973.99b
Komcalle	3601.41b	4679.50b	1042.49b	1206.84a
Tiligre	4364.50a	5648.78a	1081.85a	1250.76a
Neerwaya	4396.03a	5532.63a	1067.64ab	1231.64a
Prob.	0.0026	0.0025	<.0001	<.0001
SE±	184.09	197.44	11.67	17.17

Means followed by the same letter (s) within a treatment group are not significantly different at 5% level of probability using Student Newman Keuls (SNK) test. The figure 1 shows cowpeas varieties average yield trend. The charts indicate that the crop performs better in Kamboinse than Farako-Ba. The figure 2 indicates that no application of fertilizer in cowpea production lead to grain yield loss of about 60% if compare to control plant with recommended rate of 100 kg/ha.

**Figure 1 : Cowpeas varieties average grains yield at Farako-Ba and Kamboinse**

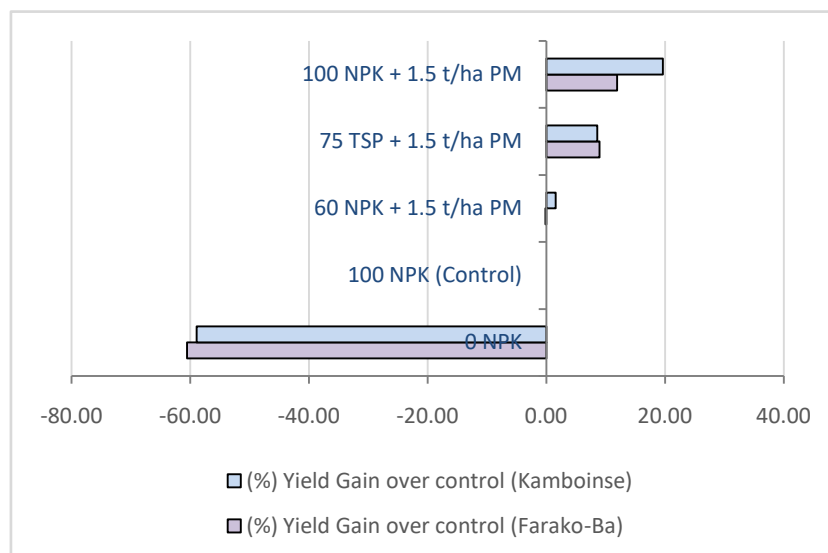


Figure 2 : Cowpea grain yield gain over the control plot at Farako-Ba and Kamboinse

Conclusion:-

The results of this study are more relevant as they can improve cowpea yield productivity. Indeed, the experiments revealed that cowpea fodder and grain yields significantly increase with treatments with combined application of poultry manure and mineral fertilizer. This study highlights the intrinsic difference of grain and fodder yield among the four cowpea genotypes involved in this study.

Recommendation:-

In sub-Saharan Africa where poor soils are among main constraint for increasing crops productivity, application of poultry manure and chemical fertilizer could restore the soils and increase crops productivity.

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