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RESEARCH ARTICLE OPEN ACCESS

Comparative Assessment of the Effect of Cow Dung and Poultry Manure on Grain Yield of Amaranthus Blitum

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ABSTRACT

Amarathus specie in the broad-based genus of annual plants, normally consumed as leafy vegetables and herbs. Amaranth crop provide grain, leafy vegetable, fodder, and greater diet than the predominant staple crops. Nutrition value and use of grain amaranth is a potential future application in bread making. The study compared the effect of organic fertilizers on the growth and yield of amaranths blitum. The study focused on: assessing the effect of organic fertilizer on the grain yield component of amaranthus blitum; and determining suitable organic fertilizer among cow dung and poultry manure to use in cultivating grain amaranth in the soil. The experiment was conducted in a Randomized Complete Block Design (RCBD)with three treatments each of which was replicated nine times.The data was collected in an interval of one-week period starting from after two weeks of planting time for a period of 12 weeks. The results indicated that the plant height was significantly higher in both season 1 and season 2 and this have been due poultry manure and cow dung. The study revealed that, the better performed treatments were the plots amended with poultry manure and cow dung. Result revealed that mean differences of number of branches of Amaranthas Blitum under treatment of cow dung and poultry manure are statistically significant resulting to L.S.D = (1.249) in season 1 while L.S.D (1.476) in season 2 resulted into not statistically significant mean differences in number of branches on treatment of both cow dung and poultry manure. While control treatment is season 1 was not statistically significant with cow dung and poultry manure treatments. Results revealed that grain yield under treatment of cow dung and poultry manure were statistically significant at 95% significance. This was confirmed by mean differences that were less than L.S.D (1.077kg) in season 1 in all treatments. The study results revealed that cow dung yielded more grains. The researcher concluded that effect of poultry manure and cow dung was significant on plant height of *Amaranthas Blitum.* The study concluded that mean differences of number of leaves under treatment of cow dung and poultry manure was statistically significant. The study concluded that the most suitable manure for grain cultivation of Amaranthas Blitum is cow dung compared to poultry manure and control treatment. It is recommended that an experiment of this nature should be conducted on farm with full participation of the farmers themselves to observe and see the outcome of the study. The study recommends that for increased production of grain yield and growth of Amaranthas blitum, cow dung organic manure should be mostly used.

Keywords:*Poultry Manure, Cow Dung, Grain Yield, Amaranthas Blitum*

Background

Vegetables are known as the cheapest and readily available sources of important proteins, minerals, vitamins, and essential amino acids. Amarathus specie in the broad-based genus of annual plants, normally consumed as leafy vegetables and herbs (Gaya *et al*., 2007). They are grown in both high and lowland areas in Uganda (Musyimi *et al*., 2009). Of all vegetables, Amaranthus species such as, A.caudatus, and A.blitum are mostly consumed. Amaranth crop provide grain, leafy vegetable, fodder, and greater diet than the predominant staple crops. Nutrition value and use of grain amaranth is a potential future application in bread making (Mlakar et al., 2009). Amaranth production is increasing but the production of grain amaranth is still low. Dietary and production values of these vegetables are restricted due to the low fertility of native soils in most parts of Uganda. The use of inorganic fertilizer to increase yield is found to be effective only within few years, demanding steady use on long-term basis. Aisha et al. (2007) there has been increased use of organic manure which are readily available to plants. Therefore, organic fertilizers can work as an alternative to mineral fertilizers. Naeem et al. (2006) for improving soil structure (Dauda et al., 2008). With the introduction of horticulture farming in Uganda and other countries including Kenya, this study seeks to compare the effect of fertilizer application on grain yield ofamaranthus blitum to determine a suitable fertilizer to apply among the poultry and cow dung for use in cultivation of grain amaranth in the soil and come up with proper organic fertilizer rate for increasing grain yield of Amaranth

Materials and methods

Chemicals reagents and fertilizers to use were purchased from Kabale District and was of analytical grade.The seeds of *Amaranthus blitum* (improved local variety) was obtained from local agro input shops in Kabale.Surface soil sample was taken from the experimental site at a depth of 0 to 15cm at land preparation after ploughing and harrowing using the zigzag method by help of a soil auger (Brady and Weil, 2008). The sample was collected from ten points and bulked to form a combined sample. The composite sample was air-dried in an oven, crushed in a motror and sieved through a 2mm mesh sieve and stored for chemical analysis.Completely Randomised Design (CRD) was used. With this design, variables were randomly applied in the treatments. Three treatments replicated three times. Plot sizes 2m by 2m separated by 1m. The total number of replicates were 18. Crop spacing was 30cm between the rows and 25 cm apart. the total experimental plot covered a space of 16m by 16m. Each replicate measured 2m by 2m with 1m spacing between replicate to replicate. The data was collected in an interval of one-week period starting from after two weeks of planting time for a period of 12 weeks. The observations were made on plant height, number of leaves, number of branches and grain yield.

The experimental results of the study were grouped, summarized and classified with the help of figures, tables and graphs. This was arranged, organized and entered into excel. Data was analysed using Genstat 11th Edition.

Study Area

The field experiment was carried out at the Faculty of Agriculture and Environmental sciences experimental garden at Kabale University. Kabale District has a tropical climate with wet environmental conditions characterized by cold air and rainfall in between December and March with two annual raining seasons.

Results

Soil Tests

Soil samples from field were obtained with a soils hand auger to a depth of 15 cm in a crop growing area and placing the samples in separate paper bags and were were taken to soil testing machine at Kabale. Soils were then combined together to come up with a composite sample which was analyzed for pH, soil organic matter (SOM), total nitrogen (TN), available phosphorus (P), exchanges bases of sodium (Na), potassium (K), magnesium (Mg), and calcium (Ca), and texture tests using standard procedure. The results obtained from the composite soil sample test favored the amaranth crop.

Soil Fertility Status

Parameter	Unit	Analysis Result	Range Low	Range High	Low	Adequate	High
pH (water)	pH Value	5.6	6.0	7.2	■		
Organic Carbon	g/kg	18	17	50		■	
Total Nitrogen	g/kg		1	2		■	
Phosphorus (M3)	mg/kg		20	40	■		
Potassium (exch.)	mmol+/kg		1.5	3		■	
Clay	%	35	20	40		■	
Cation Exchange Capacity	mmol+/kg	48	75	200	■		
Soil moisture	%	24.6	10	30		■	

Figure 1: Soil testing results

Plant height

The results of analysis of variance showed that the interaction of cow dung and poultry manure had a very significant effect on plant height of Amaranthus blitum. The plant height in both seasons was statistically significant. The average plant height of Amaranthus blitum due to cow dung and poultry manure can be seen in table below.

Table 1: Tables of means of Plant Height

Treatment	Season 1	Season 2
Grand mean	120.2	124
	Mean	**Mean**
Control	103.3	104
Cow Dung	129.3	138
Poultry Manure	127.9	130

Results showed that the average plant height in season 1 was 120.2 cm and average plant height in season 2 was 124 cm. In season 1, cow dung yielded more plant height (129.3cm) and in season 2, it yielded plant height (138cm) which is more than mean plant height for poultry manure (130cm) and control (104cm). This showed that cow dung is better manure to be used amaranths growing.

Table 2: Fisher's protected least significant difference test

Treatment	Season 1	Season 2
	Mean	**Mean**
Control	103.3 a	104 a
Poultry Manure	127.9b	130 b
Cow Dung	129.3b	138 b
l.s.d.	8.87	9.9

Results from analysis of variance showed that the f-probability is less than 0.05. This showed that variables were statistically significant. Both experiments in season 1 and season 2 yielded statistically significant results (F-pr=0.001) at significance level of 5%. This implied that mean differences of plant height under treatment of cow dung and poultry manure were statistically significant as indicated by l.s.d (8.87) in season 1 and l.s.d (9.9). While control treatment was not statistically significant with other treatments in both season 1 and season 2.

Number of leaves

The results of analysis of variance showed that the interaction of cow dung and poultry manure had a very significant effect on number of leaves of Amaranthus blitum in season 1. The plant height in season 1 was statistically significant. The average number of leaves of Amaranthus blitum due to cow dung and poultry manure can be seen in table below.

Table 3: Analysis of variance of Number of leaves

Season 1					
Source of variation	**d.f.**	**s.s.**	**m.s.**	**v.r.**	**F pr.**
Treatment	2	948.02	474.01	31.71	<.001
Residual	1077	16100.04	14.95		
Total	1079	17048.07			
Season 2					
TREATMENT	2	1454.9	727.5	2.10	0.123
Residual	1077	373415.3	346.7		
Total	1079	374870.3			

Table 4:Fisher's protected least significant difference test

Treatment	**Season 1**	**Season 2**
	Mean	**Mean**
Control	10.64a	12.51 a
Poultry Manure	12.33b	15.41 b
Cow Dung	12.83 b	18.29 c
l.s.d.	0.565	2.723

Results from analysis of variance showed that the f-pr was less than 0.05 in season 1 and greater than 0.05 in season 2. This showed that treatments are statistically significant in season 1 while in season two, treatments were not statistically significant. Experiment in season 1 yielded statistically significant results (F-pr=0.001) at significance level of 5%. While in season 2, treatment yielded results that were not statistically significant (F-pr=0.123). This implied that mean differences of plant height under treatment of cow dung and poultry manure are statistically significant as indicated by l.s.d (0.565) in season 1 while l.s.d (2.723) in season 2 indicated that treatments were not statistically significant. While control treatment is season 1 was not statistically significant with cow dung and poultry manure treatments.

Number of branches

The results of analysis of variance showed that the interaction of cow dung and poultry manure had a very significant effect on number of branches of Amaranthus blitum in season 1.

Table 5: Analysis of variance of Number of branches

Season 1					
Source of variation	**d.f.**	**s.s.**	**m.s.**	**v.r.**	**F pr.**
Treatment	2	2102.11	1052.56	14.42	<.001
Residual	1077	78591.11	72.97		
Total	1079	80696.22			
Season 2					
Source of variation	**d.f.**	**s.s.**	**m.s.**	**v.r.**	**F pr.**
Treatment	2	104.5	52.3	0.51	0.599
Residual	1077	109680.5	101.8		
Total	1079	109785.0			

Table 6: Fisher's protected least significant difference test

Treatment	**Season 1**	**Season 2**
	Mean	**Mean**
Control	5.097a	5.097a
Poultry Manure	7.378 b	7.378 b
Cow Dung	8.444 b	8.444 b
l.s.d.	1.249	1.476

Results from analysis of variance of number of branches showed that the F-pr was less than 0.05 in season 1 and greater than 0.05 in season 2. This showed that treatments are statistically significant in season 1 (F-pr=0.001) while in season two, treatments were not statistically significant (F-pr=0.599). Experiment in season 1 yielded statistically significant results (F-pr=0.001) at significance level of 5%. While in season 2, treatment yielded results that were not statistically significant (F-pr=0.599). This implied that mean differences of number of branches of Amaranthas Blitum under treatment of cow dung and poultry manure are statistically significant resulting to l.s.d = (1.249) in season 1 while l.s.d (1.476) in season 2 resulted into not statistically significant mean differences in number of branches on treatment of both cow dung and poultry manure. While control treatment is season 1 was not statistically significant with cow dung and poultry manure treatments.

Effect of organic fertilizer on the grain yield component of amaranthus blitum

Grain yield

The results of analysis of variance showed that the interaction of cow dung and poultry manure had a very significant effect on grain yield of Amaranthus blitum.

Table 7: Tables of means of Grain yield

Treatment	**Season 1**	**Season 2**
Grand mean	**2.09**	**3.18**
	Mean	**Mean**
Control	1.57	2.81
Cow Dung	2.58	3.35
Poultry Manure	2.12	3.37

Results showed the computed grain yield for season 1 and season 2. Season 1 yielded average grain mean (2.09 kg) and season 2 yielded average mean grain mean (3.18kg). cow dung (2.58kg) yielded much more weight grains, poultry yielded 2.12kg and control yielded 1.57kg in season. While in season 2, poultry manure yielded 3.37kg of grains, cow dung yielded 3.35 and control yielded 2.81kg. Cow dung treatment yielded more grain compared to both poultry manure and control treatment. But Poultry manure yielded more grains compared o control treatment.

Table 8: Analysis of variance of Weight of Grain

Season 1					
Source of variation	**d.f.**	**s.s.**	**m.s.**	**v.r.**	**F pr.**
Treatment	2	3.0586	1.5293	2.00	0.170
Residual	15	11.4958	0.7664		
Total	17	14.5544			
Season 2					
Source of variation	**d.f.**	**s.s.**	**m.s.**	**v.r.**	**F pr.**
Treatment	2	1.1885	0.5943	0.86	0.442
Residual	15	10.3406	0.6894		
Total	17	11.5291			

Table 9: Fisher's protected least significant difference test

Treatment	**Season 1**	**Season 2**
	Mean	**Mean**
Control	1.835	2.996 a
Poultry Manure	2.110	3.265 b

Cow Dung	2.338	3.271b
l.s.d.	1.077	1.022

Results from analysis of variance on grain yield under treatment of cow dung and poultry manure were statistically significant at 95% significance. This was confirmed by mean differences that were less than L.S.D (1.077kg) in season 1 in all treatments. In season, the grain yield was statistically significant under treatment of cow dung and poultry manure and not statistically significant with control treatment.

Suitable organic fertilizer among cow dung and poultry manure to use in cultivating grain amaranth in the soil

There was positive impact of manure application either as poultry manure or cow dung over the control on grain yield related parameters in amaranths blitum must have resulted from the ability of these materials to complement soil organic matter by adding manures such as cow dung, and poultry manure which are vital to crop growth and development. Cow dung yielded more grain compared to both poultry manure and control in both seasons. Therefore, the study recommends that for proper growth and development of Amaranthus blitum, cow dung should always be used in cultivating grain amaranth in the soil.

Discussions

The results indicated that the plant height was significantly higher in both season 1 and season 2 and this have been due poultry manure and cow dung that could have offered the plants higher nutrients for a better increase in the height of the plant immediately it was applied. Palada and Chang, (2013) reported that, *Amaranthus is* known to be a low management crop that can grow in poor soils but yield can be improved by organic manure. The poultry manure application showed significant effect as well, and it could be that the soil amendment had effect on both soil nutrients and soil structure. Van Averbeke and Yoganathan (1997) reported that, poultry manure contains all the nutrients required for plant growth and hence it is important to apply enough manure to meet crop requirements. Myers (1998) and Schippers (2010) reported that *Amaranthus* response well to good soil fertility and organic matter.

Also, the growth components of amarantas blitum generally responded to poultry manure applications and cow dung agrees with the results obtained by Chang, (2013) who found out that application of organic waste, poultry droppings increases growth and yield components of Capsicum significantly. However, considering that there were no uniformity in plant heights at transplanting, drawing inference based on height variations as reflected every two weeks may be misleading; as this may not reflect the

true picture of the applied treatment on this parameter. However, considering the total height gained may give a better picture of the effect of P application on the subject crop. As this latter parameter will reflect the contribution of the applied treatment to crop growth.

The results revealed that, the better performed treatments were the plots amended with poultry manure and cow dung. This implied that mean differences of number of leaves under treatment of cow dung and poultry manure are statistically significant as indicated by L.S.D (0.565) in season 1 while L.S.D (2.723) in season 2 indicated that treatments were not statistically significant. While control treatment is season 1 was not statistically significant with cow dung and poultry manure treatments. This could be that the base soil used was deficient in soil pH and hence amendment could have added more soil pH to the soil that could have led to the significant difference between control and poultry and cow dung manure treatments. It could also be due to that, *Amaranthus* takes short period to mature (short lived plant) and manure slowly releases nutrients into the soil that might have slow response among the chicken manure amended plots. Van Averbeke and Yoganathan, (1997) explained that, chicken manure has all the nutritional requirements for plant growth and that it is important to apply enough of it to meet the crop needs.

Result revealed that mean differences of number of branches of Amaranthas Blitum under treatment of cow dung and poultry manure are statistically significant resulting to L.S.D = (1.249) in season 1 while L.S.D (1.476) in season 2 resulted into not statistically significant mean differences in number of branches on treatment of both cow dung and poultry manure. While control treatment is season 1 was not statistically significant with cow dung and poultry manure treatments. This resulted in significant difference within all the types of manure applied on the number of branches of the crop. The significant effect shown in number of branches due to poultry manure treatments could be that, the amendment had positive effect on the output notwithstanding the slow release of its nutrients. Also, it could be that the poultry manure was able to bind the soil particles together for better soil water retention thereby making water available for the plants use.

Pagliai and Vignozzi (1998) stated that, agronomic use of manure improves the physical conditions of soils, such as soil structure as well as the chemical compositions of the soil. Studies by Ayoola and Adeniyan (2006) however, revealed that the use of inorganic fertilizers has not been helpful in agriculture because it does not improve on the structure of the soil.

Results revealed that grain yield under treatment of cow dung and poultry manure were statistically significant at 95% significance. This was confirmed by mean differences that were less than L.S.D (1.077kg) in season 1 in all treatments. The results also revealed that Cow dung treatment yielded more

grain compared to both poultry manure and control treatment. But Poultry manure yielded more grains compared to control treatment.

The positive impact of manure application either as poultry manure or cow dung over the control on growth related parameters in *Amarantahs blitum* must have resulted from the ability of these materials to compliment soil organic matter by adding mineral such as N, P and K which are vital to crop growth and development (Gomez, 2014; Oyewole et al., 2012). The almost better performance obtained with the application of poultry manure over cow dung may have to do with higher percentage of these nutrients in poultry manure as revealed in the laboratory test analysis (Oyewole, & Oyewole, 2010). This observation is in agreement with previous findings (Gomez, 2014; Oyewole et al., 2012).

The study results revealed that cow dung yielded more grains compared to both poultry manure and control in both seasons. Therefore, the suitable manure for proper growth and development of *Amaranthus blitum* is cow dung and should always be used in cultivating grain amaranth in the soil.

Conclusionand recommendations

The researcher concluded that effect of poultry manure and cow dung was significant on plant height of *Amaranthas Blitum*in both season 1 and season 2. Based on the results, the study concluded that mean differences of number of leaves under treatment of cow dung and poultry manure was statistically significant as indicated by L.S.D (0.565) in season 1 while L.S.D (2.723) in season 2 indicated that treatments were not statistically significant. The researcher concluded cow dung and poultry manure had effect on the number of branches of Amaranthas blitum since the that mean differences of number of branches of Amaranthas Blitum under treatment of cow dung and poultry manure were statistically. The researcher also concludes that control treatment had no effect on the number of branches of Amaranthas Blitum. atments. It was concluded that cow dung had more effect on grain yield of Amaranthas Blitum compared to poultry manure and control treatment.The researcher concluded that poultry manure had much effect on grain yield of Amaranthas Blitum compared to control treatment. The study concluded that the most suitable manure for grain cultivation of Amaranthas Blitum is cow dung compared to poultry manure and control treatment.

Several experiments of this nature should be repeated within the study district on the field to ascertain the results obtained.

The study recommends that for increased production of grain yield and growth of Amaranthas blitum, cow dung organic manure should be mostly used.

More research is needed considering the following aspect: To try other improvedamaranth varieties or genotypes. Inclusion of other organic plant macronutrients beside poultry manure, and cow dung and micronutrients in the research of amaranth.

Authors' abbreviations

KJ: Kato Joel, **DO**: DavidOsiru, **FO**: FinaOpio

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Authors' contributions

The authors of this manuscript made the following contributions to this manuscript Concept: KJ,conceived the concept, Data collection; KJ, DO: Data analysis: First draft: KJ, DO, FO, Finalrevision: KJ, DO, FO, Read and approved final manuscript: KJ, DO, FO.

Competing interests

The authors declare that they have no competing interests.

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