Research Journal of Forestry

ISSN 1819-3439

Academic Journals Inc.

www.academicjournals.com

OPEN ACCESS Research Journal of Forestry

ISSN 1819-3439
DOI: 10.3923/rjf.2019.1.8

Research Article
Assessment of Seed Germination and Organic Manure Application on the Early Growth of *Eucalyptus camaldulensis* L. Seedlings

Agera Stephen Iorliam Naishima, Peter Micah Kalu and Amonum Joseph Igba

Department of Forest Production and Products, College of Forestry and Fisheries, University of Agriculture, Makurdi, P.M.B. 2373 Makurdi, Benue State, Nigeria

Abstract

Background and Objective: Human population explosion, non-sustainable agriculture and tree logging destroy natural forests, prompting reforestation with fast growing tree species using artificial cultural methods. This study investigated the effects of cow dung and poultry droppings on the germination and early growth of *Eucalyptus camaldulensis* L. seedlings at the Forestry Nursery in Jos, Nigeria. **Materials and Methods:** Using the randomized complete block design (RCBD), laboratory-tested soil samples, poultry droppings, poultry droppings plus cow dung, cow dung alone and a control (top soil only) were used in various combinations to assess the growth parameters of *E. camaldulensis* (seedling emergence, plant height, number of leaves, length of leaves and stem diameter) for 12 weeks. Percentages, means and relative frequency distribution were used to analyze collected data. **Results:** Results indicated that poultry droppings had the highest nitrogen concentration (3.2%), cow dung (2.9%) and top soil (0.070%). Treatments with poultry droppings gave the greatest plant height, number of leaves and stem diameter (girth) followed by the mixture of poultry droppings and cow dung while top soil (control) recorded the lowest growth. Mixture of poultry droppings and cow dung produced the greatest leaf length, compared to poultry droppings, cow dung and the control, respectively. **Conclusion:** Thus poultry dropping is recommended as the most suitable organic manure for nurturing juvenile seedlings of *E. camaldulensis* in the nursery for plantation purposes.

Key words: *Eucalyptus camaldulensis*, germination, growth and organic manure

Citation: Agera Stephen Iorliam Naishima, Peter Micah Kalu and Amonum Joseph Igba, 2019. Assessment of seed germination and organic manure application on the Early growth of *Eucalyptus camaldulensis* L. seedlings. Res. J. For., 13: 1-8.

Corresponding Author: Agera Stephen Iorliam Naishima, Department of Forest Production and Products, College of Forestry and Fisheries, University of Agriculture, Makurdi, P.M.B. 2373 Makurdi, Benue State, Nigeria Tel: +2348058484045

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Eucalyptus camaldulensis Dehnh, an evergreen tree belongs to the Family Myrtaceae. It usually grows between 40-45 m in height, depending on its location and it is often planted for shade, windbreak, ornamental, amenity purposes and as a source of nectar to produce high-quality honey[1]. It is a widely used afforestation species due to its fast growth, high productivity and short rotation[2]. The tree grows straight under favourable conditions but can develop twisted branches in drier conditions[3]. Organic matter is a vital soil component influencing the physical, chemical and microbiological properties of soil to a great extent. Decrease in bulk density with the addition of organic matter has been documented[4]. The use of organic manures enhances increased soil organic matter and total nitrogen (N), increased the effectiveness of soil phosphorous (P), increased population of soil organisms, especially some bacteria and increased activities of some soil enzymes such as urease, improves soil structure, aeration, soil moisture-holding capacity and water infiltration[5]. Manure applied to field plots also risked the subsurface water and groundwater quality if handled improperly[6].

Organic manure decreases the danger of over-fertilization because the nutrients are released slowly. Using organic fertilizer adds more natural nutrients, feeds important microbes in the soil and improves the structure of the soil[7]. Poultry manure contains a high percentage of nitrogen and phosphorus for the healthy growth of plants[8]. Nitrogen is equally said to be the motor of plant growth[9]. Organic matter is the ultimate determinant of the soil fertility in most tropical soils and this accounts for its use to raise seedlings in tropical areas, the fertility of the soil could be sustained with the addition of poultry manure[10].

Cow dung is a very good source for maintaining the production capacity of soil and enhances the microbial population. It is an important input for maintaining and enhancing soil fertility[11]. The application of cow dung manure increases soil organic matter content, improves water infiltration and water holding capacity as well as an increased cation exchange capacity. The C: N ratio in cow dung manure is an indication that it could be a good source of protein for the microbes which involved in decomposition of organic matter Dung increased pH, CEC, total N, organic C, loss on ignition and exchangeable Mg and Ca[12]. It decreased sulphate sorption. Moreover, cow dung manure plays a significant role in maintaining the nutrient status of the plant. Dung may also be used to produce bio-gas to generate electricity and heat. The gas, rich in methane is used in rural areas of India, Pakistan and elsewhere to provide a renewable source of electricity[13].

This study was conceived to experiment on organic manures as a possible boost to seedling growth in nurseries to enhance decreased rotation period in plantations. The specific objectives were to: (a) Assess the growth responses of *Eucalyptus camaldulensis* to various application rates of poultry droppings and (b) Assess the growth responses of *Eucalyptus camaldulensis* to various application rates of cow dung manure.

MATERIALS AND METHODS

Study area: The study was conducted within the nursery of the Department of Forestry Technology, Federal College of Forestry in Jos, Plateau state. The study area lies in the northern Guinea Savanna situated on latitude 9° 57' N and longitude 8° 54' E with an elevation of about 118 cm above sea level. The mean annual rainfall for the location is between 1200 and 1250 mm and means temperature ranges between 23 and 25°C. The soil is sandy-loam, light to dark in colour. The climate of the state is cool due to its high altitude and rainy season is usually between April and September while dry season is from October-March[14].

Soil sample collection and analysis: All soil samples collected for routine analysis were carefully labeled for identification and taken to the chemistry laboratory of the Federal College of Forestry, Jos where the samples were air dried at room temperature. The air dried samples were then crushed using a mortar and then sieved using a 2.00 mm diameter sieve. The sieved samples were taken to the Agricultural Service Training Center (ASTC), Kassa, Vom, Plateau state, Nigeria for routine analysis. The chemical composition of the soil and organic matter sources, viz: pH, N, organic matter, P, Na, Ca, Mg and K concentrations were assessed using standard procedures as outlined by Soil and Plant Analysis Council[15].

Research design: A total number of 36 perforated polythene bags (20×5 cm) containing 3 kg of soil were laid out in a randomized complete block design (RCBD) with 4 treatments (poultry droppings, cow dung, poultry droppings plus cow dung and a control-without organic matter). Poultry droppings and cow dung were each applied at the rate of 2 kg per 3 kg of soil before sowing[16]. The samples that were left without treatment served as the control. The treatments were replicated.

Seed planting, assessment of germination and growth: About 1 g of *Eucalyptus camaldulensis* seeds obtained from

Federal College of Forestry, Jos nursery were planted on each of the soil mixtures by broadcasting and later thinned to one stand per pot 2 weeks after germination[16].

A week after planting, data on seedling emergence was taken to assess the germination. Seedling emergence was taken and recorded from the very 1st day of germination. Plant heigh (cm) was taken weekly from the soil level (base) to the tip using a graduated meter rule. The leaves of every seedling in the replicates were counted and the mean per replicate was determined. Leaf length was measured with a meter rule, stem diameter was measured using a thread, clung around the stem of each seedling and read against a graduated meter rule (in centimeters).

Statistical analysis: The data obtained was subjected to descriptive (percentages and relative frequencies) and inferential one way statistical analysis of variance to determine their significance at 5% level using Statistical Package for Social Sciences (SPSS) version 19. Means were separated using Fisher's least significance difference ($p \leq 0.05$).

RESULTS

Chemical analysis of top soil, poultry droppings and cow dung: The pH of the planting media samples in both distilled water and $CaCl_2$ (paired in brackets, respectively), were slightly alkaline in nature for both poultry droppings (8.20 and 8.0) and cow dung (8.0 and 7.6) while soil pH was slightly acidic (5.95 and 5.35) (Table 1). Percentage nitrogen concentration was higher in poultry droppings (3.2%) than in cow dung (2.9%) and top soil (0.070%). Organic matter content was highest in poultry droppings (58.10%) than in cow dung (28.30%) and soil (2.42%). Phosphorus concentration was highest in the soil (6.30 ppm) than in poultry droppings and cow dung. For exchangeable bases, sodium (Na) was highest in poultry droppings (1.32 ppm) followed by cow dung and soil. The results on calcium, magnesium and potassium were highest in soil than in poultry droppings and cow dung. The soil CEC was 4.05 mMol/100 g.

Effect of organic manure application on germination of *Eucalyptus camaldulensis* seeds: The effect of organic manure on germination of *Eucalyptus camaldulensis* seeds is shown in Fig. 1. The germination of *Eucalyptus camaldulensis* after 1 week of planting showed highest mean percentage germination in poultry droppings treatments and the differences observed were far more significant than

Table 1: Chemical properties of soil, poultry droppings and cow dung used in potting mixtures

Sample description	PH		N	OM	p-value	Exchangeable bases (ppm)				Exchangeable acidity (mMol/100 g)	CEC (mMol/100 g)	Clay (%)	Silt (%)	Sand (%)	Textural class
	H_2O	$CaCl_2$	(%)	(%)		Na	Ca	Mg	K	Al^{3+}					
Soil	5.95	5.35	0.070	2.42	6.30	1.19	624.00	123.00	95.00	Nil	4.05	14.24	18.0	67.76	LS
PD	8.20	8.00	3.200	58.10	2.46	1.32	2.86	0.61	1.36						
CD	8.00	7.60	2.900	28.30	2.36	1.28	2.02	0.48	1.52						

PD: Poultry dropping, CD: Cow dung, Om: Organic matter, LS: Loamy sand N, OM, P, Na, Ca, Mg and K concentrations for poultry droppings and cow dung highlighted in Table 1 is in percentages

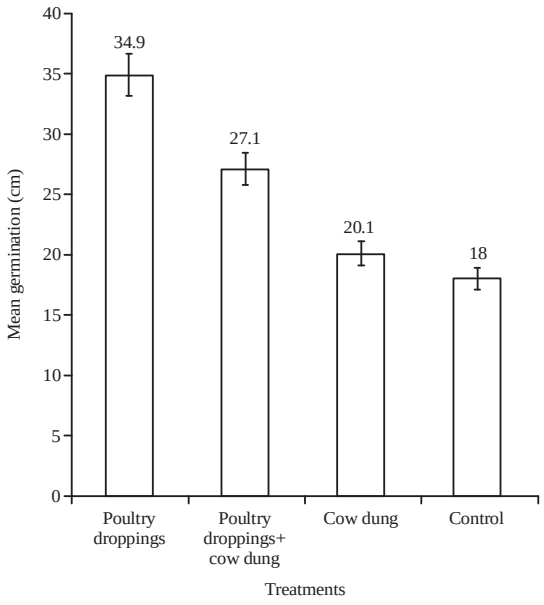

Fig. 1: Effect of different organic manures on germination of *Eucalyptus camaldulensis*

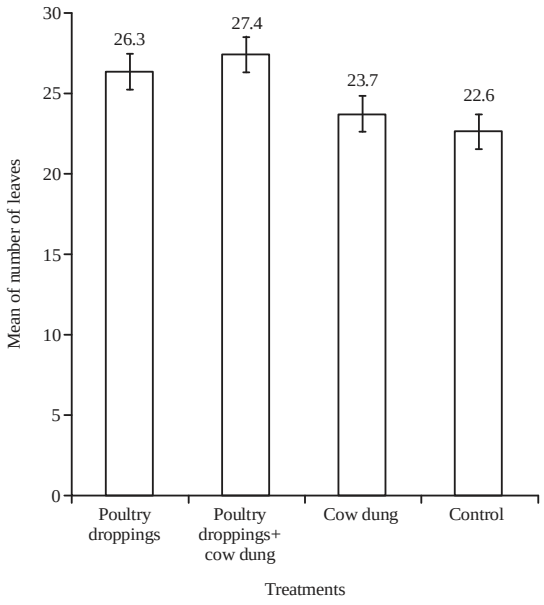

Fig. 2: Effect of different organic manures on average number of *Eucalyptus camaldulensis* leaves

the rest of the treatments. The decreasing order of mean percentage germination were PD (34.9%)>PD+CD (27.1%)>CD (20.1%)>CTRL (18.0%).

Effect of organic manure application on leaf count of *Eucalyptus camaldulensis* seedlings: The effect of organic manure on average number of *Eucalyptus camaldulensis* leaves is shown in Fig. 2. The average number of leaves after 1 week of planting had the highest mean percentage value in the poly pot treated with combination of poultry droppings and cow dung (PD+CD). The order of performance on mean number of leaves are was:

PD+CD (27.4%)>PD (26.3%)>CD (23.7%)>CTRL (22.6%)

Effect of organic manure application on height of *Eucalyptus camaldulensis* seedlings: Figure 3 shows the trends in shoot height growth following application of the poultry droppings, cow dung and poultry droppings plus cow dung on the germination and early growth of *E. camaldulensis*. Growth values recorded for each treatment increased as the age of the seedlings progressed after seed germinated from 2-12 weeks and the highest value for each stage was obtained from the poly pots treated with poultry droppings (PD) and the order of increase from 2-12 weeks were:

PD>PD+ CD>CD>CTRL

Figure 4 indicates the incremental number of leaves of *E. camaldulensis* seedlings post-germination. Poultry droppings and cow dung application showed significant differences in the number of leaves formed on the seedlings ($p<0.05$). The poly pots treated with cow dung gave the highest number of leaves and the decreasing order of number of leaves formed based on treatment was thus:

PD>PD+CD>CTRL

Effect of organic manure application on leaf length of *Eucalyptus camaldulensis* seedlings: There was a significant increase in length of leaves as the seedling age increased and the highest leave length was obtained from poly pots treated with PD+CD (Fig. 5). The result also revealed highest leave length values between 4-7 weeks for poly pots treated with poultry droppings and order of increase between these weeks were:

PD>PD+CD>CD>CTRL

Effect of organic manure application stem diameter of *Eucalyptus camaldulensis* seedlings: Treatments with poultry droppings and cow dung were significantly different ($p<0.05$) (Fig. 6) for stem diameter (girth) of

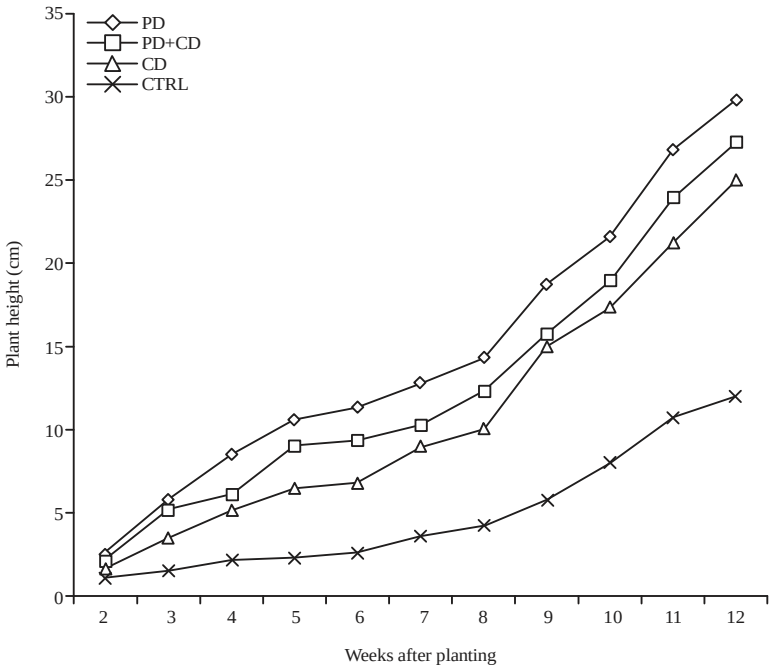

Fig. 3: Trend graph on mean effects of application of different manure treatments on plant height of *Eucalyptus camaldulensis*

PD: Poultry droppings, CD: Cow dung, PD+CD: Poultry droppings plus cow dung, CTRL: Control, WAP: Weeks after planting

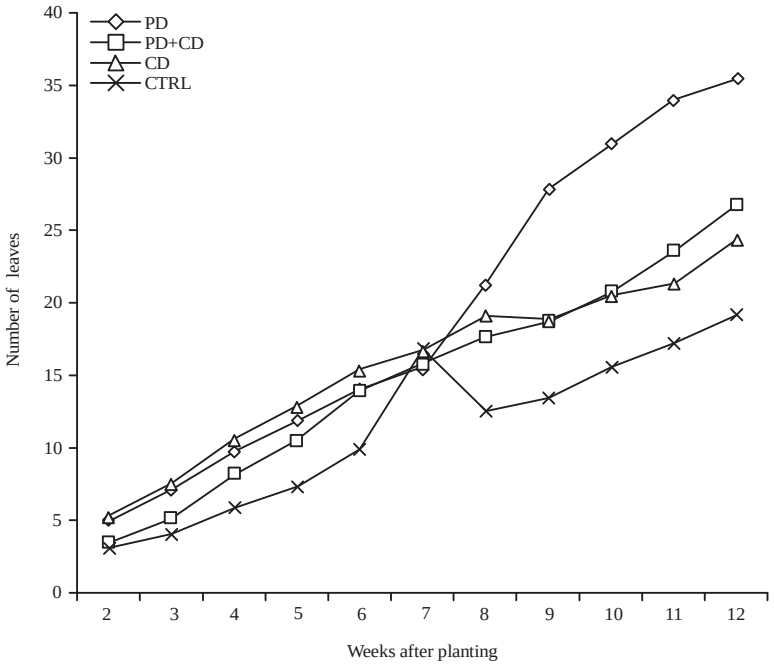

Fig. 4: Trend graph on mean effects of application of poultry droppings and cow dung manure on number of leaves of *Eucalyptus camaldulensis*

E. camaldulensis between 2-12th weeks. The results revealed that the values recorded for each treatment increased with seedling age from 2-12th week and the highest value was obtained from the poly pots treated with poultry droppings.

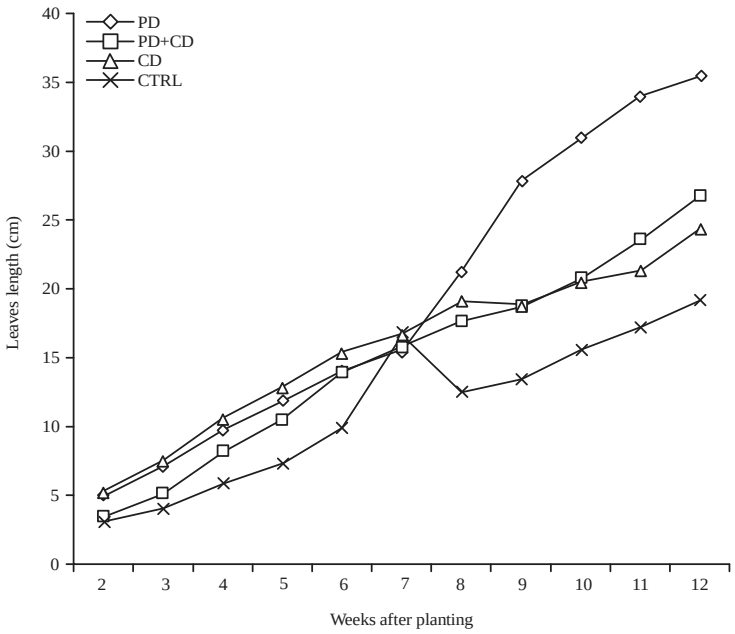

Fig. 5: Trend graph on mean effects of individual or combined application of poultry droppings and cow dung manure on leaf length of *Eucalyptus camaldulensis*

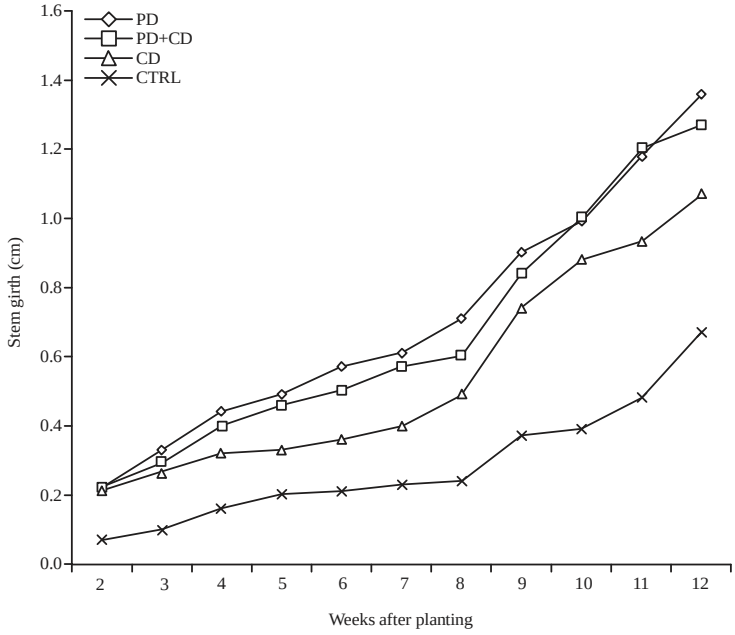

Fig. 6: Trend graph on mean effects of individual or combined application of poultry droppings and cow dung manure on stem diameter (girth) of *Eucalyptus camaldulensis*
Source: Field survey

DISCUSSION

The pH in both distilled water and $CaCl_2$ were slightly alkaline in nature for both poultry droppings while that of soil was slightly acidic (5.95 and 5.35). Percentage nitrogen was higher in poultry droppings (3.2%) than in cow dung (2.9%) and soil (0.070%). These findings are in consonance with Ewulo[8], who noted that the chemical properties of poultry droppings amended soils for better enhanced plant growth than cow dung manure.

The highest mean germination values were observed in poultry droppings treated poly pots at a rate of 2 kg per 3 kg of soil. The results agree with the findings of Okunomo[17], in *Parkia bicolor* (*A. cheu*) production which reported that organic manure, especially poultry droppings could have higher number of seed germination when compared with other source of manures[17]. The increase in growth of seedlings with poultry droppings application stressed its importance during the seedling emergence of tree plants[18].

The germination and early growth of *Eucalyptus camaldulensis* were increased with organic matter application and the highest values were observed in treatments with poultry droppings (PD) followed by the treatments containing poultry droppings and cow dung (PD+CD), cow dung (CD) and the control. The result agrees with findings of Ghanbarian *et al*.[19] and Bahl and Toor[20], who reported that poultry droppings contained higher concentrations of nitrogen and phosphorus. Uka *et al*.[16] also observed that the application of poultry droppings to *Abelmoschus esculentus* seedlings more significantly increased the plant height, leaf area, leaf number and fresh weight compared with the application of cow dung manure[16]. The highest leaf number of *Eucalyptus camaldulensis* seedlings recorded under poultry droppings at that period revealed a better performance of these seedlings. This was in agreement with findings by Edmeades and Lafitte[21] as well as Tindall[22], who reported that the reasons for higher performance are attributable to higher nitrogen concentrations.

Poultry manure and cow dung manure were richer in their nitrogen and other nutrient content. This condition created better nutrient absorption which favoured faster vegetative growth. Consequently, highest leaf length was found by PD+CD. This is in consonance with reports recorded by other investigators such as Abou El-Magd *et al*.[3], who stated that the greatest leaf length after trails between October, 2007 and December, 2007 was recorded from poultry manure[3].

The result further agrees with Imoro *et al*.[23], who indicated that both poultry manure and cow dung are valuable sources of fertilizers for the growth of tree seedlings because they have greatly improved growth performance of vegetative parts of treated plants[23].

Stem diameter (girth) of the seedlings was highest with poultry droppings followed by treatment a with mixture of poultry droppings and cow dung, cow dung and control, respectively. This is in line with the findings of Imoro *et al*.[23], who stated that poultry manure produces better growth attributes such as stem girth than its counterparts produced and this may probably be due to the fact that poultry droppings contains more concentrated nutrients and hence led to enhanced plant growth performance in seedlings of plants treated with poultry droppings[23]. This study is also supported by the studies of Okunomo and Bosah[24], Amhakhian *et al*.[25] and Okunomo *et al*.[26], who reported the importance of poultry droppings for good growth, stem development and suitability of tree seedlings in terms of mineralization.

CONCLUSION AND RECOMMENDATIONS

The application of poultry droppings alone had the highest effect on the germination and growth of *Eucalyptus camaldulensis* compared to the combination of poultry dropping and cow dung (PD+CD), cow dung (CD) and control (CTRL). In the nursery management of *E. camaldulensis* seedlings, poultry droppings is recommended as an organic manure for enhanced fast germination and sustained vigorous growth of *Eucalyptus camaldulensis* seedlings. Since cow dung has less nutrients compared to poultry droppings, it can alternatively be mixed with poultry droppings to improve on germination and growth of *Eucalyptus camaldulensis* seedlings.

SIGNIFICANCE STATEMENT

This study discovered that poultry droppings as an organic manure source was richer in nutrients compared to other potting media used. This elevated nutrient status enhanced germination and sustained the growth of the *Eucalyptus camaldulensis* seedlings better than cow dung and topsoil. This result can help commercial nursery operators to use nutrient-rich organic manure sources like poultry droppings in raising vigorous seedlings in nurseries within a shorter time frame.

REFERENCES

1. Orwa, C., A. Mutua, R. Kindt, R. Jamnadass and A. Simons, 2009. Agroforestry database: A tree reference and selection guide version 4.0. World Agroforestry Centre, Nairobi, Kenya.
2. Kebebew, Z., 2010. Eucalyptus in rural livelihood safety net strategy in coffee growing area: Case study around jimma, Southwestern Ethiopia. Res. J. For., 4: 202-207.
3. Abou El-Magd, M.M., A.M. El-Bassiony and Z.F. Fawzy, 2006. Effect of organic manure with or without chemical fertilizers on growth, yield and quality of some varieties of broccoli plants. J. Applied Sci. Res., 2: 791-798.
4. Tejada, M., M.T. Hernandez and C. Garcia, 2006. Application of two organic amendments on soil restoration: Effects on the soil biological properties. J. Environ. Qual., 35: 1010-1017.

5. Dou, Z., D.T. Galligan, R.D. Allshouse, J.D. Toth, C.F. Ramberg and J.D. Ferguson, 2001. Manure sampling for nutrient analysis: Variability and sampling efficacy. J. Environ. Qual., 30: 1432-1437.
6. De Vos, J.A., D. Hesterberg and P.A.C. Raats, 2000. Nitrate leaching in a tile-drained silt loam soil. Soil Sci. Soc. Am. J., 64: 517-527.
7. Al-Kaisi, M. and M.A. Licht, 2004. Effect of strip tillage on corn nitrogen uptake and residual soil nitrate accumulation compared with no-tillage and chisel plow. Agron. J., 96: 1164-1171.
8. Ewulo, B.S., 2005. Effect of poultry dung and cattle manure on chemical properties of clay and sandy clay loam soil. J. Anim. Vet. Adv., 4: 839-841.
9. IFA/FAO., 2000. Fertilizers and their Use: A Pocket Guide for Extension Officers. Food and Agriculture Organization of the United Nations, International Fertilizer Industry Association, Rome Italy, ISBN-13: 9789251044148, Pages: 70.
10. Ikpe, F.N. and J.M. Powel, 2002. Nutrient cycling practices and changes in soil properties in the crop-livestock farming systems of western Niger Republic of West Africa. Nutr. Cycl. Agroecosyst., 62: 37-45.
11. Bargali, S.S., 2004. Cow dung burning is a treat to sustainable agriculture. Proceedings of the National Seminar on Ecology and Environment Management: Issues and Research Needs, January 8-9, 2004, Department of Botany, Kurukshetra University, Kurukshetra, India.
12. Adegunloye, D.V., F.C. Adetuyi, F.A. Akinyosoye and M.O. Doyeni, 2007. Microbial analysis of compost using cowdung as booster. Pak. J. Nutr., 6: 506-510.
13. Dittrich, A.D.K. and A.J. Helden, 2012. Experimental sward islets: The effect of dung and fertilisation on Hemiptera and Araneae. Insect Conserv. Divers., 5: 46-56.
14. Alao, D.A. and A.E. Adeoye, 2004. Environmental impact assessment of mine tailings of abandon tin quarries at Barkin Ladi, Plateau State. Proceedings of the 5th International Conference of the Nigerian Institute of Agricultural Engineers, November 28-December 2, 2004, Ilorin, Nigeria, pp: 154-159.
15. Soil and Plant Analysis Council Inc., 1999. Soil Analysis: Handbook of Reference Methods. CRC Press, Boca Raton, FL., USA., ISBN-13: 9780849302053, Pages: 264.
16. Uka, U.N., K.S. Chukwuka and M. Iwuagwu, 2013. Relative effect of organic and inorganic fertilizers on the growth of okra [*Abelmoschus esculentus* (L.) Moench]. J. Agric. Sci., 58: 159-166.
17. Okunomo, K., 2010. Effect of organic manure on seedling growth and development of *Tetraplura tetraptra* (Taub). Niger. J. Res. Prod., Vol. 16, No. 1.
18. Agboola, D.A. and M.O. Adedire, 2002. Response of treated dormant seeds of tropical tree species of germination promoters. Niger. J. Bot., 11: 103-110.
19. Ghanbarian, D., S. Youneji, S. Fallah and A. Farhadi, 2008. Effect of broiler litter on physical properties, growth and yield of two cultivars of cantaloupe (*Cucumis melo* L.). Int. J. Agric. Biol., 10: 697-700.
20. Bahl, G.S. and G.S. Toor, 2002. Influence of poultry manure on phosphorus availability and the standard phosphate requirement of crop estimated from quantity-intensity relationships in different soils. Bioresour. Technol., 85: 317-322.
21. Edmeades, G.O. and H.R. Lafitte, 1993. Defoliation and plant density effects on maize selected for reduced plant height. Agron. J., 85: 850-857.
22. Tindall, H.D., 1983. Vegetables in the Tropics. 1st Edn., Macmillan Press, London, UK., Pages: 533.
23. Imoro, A.W.M., I. Sackey and A.H. Abubakari, 2012. Preliminary study on the effects of two different sources of organic manure on the growth performance of *Moringa oleifera* seedlings. J. Biol. Agric. Healthcare, 2: 147-158.
24. Okunomo, K. and B.O. Bosah, 2007. Effect of organic manure on seedling growth and development of *A. Senegal*. Agric. J., 2: 685-687.
25. Amhakhian, S.O. and I.B. Isaac, 2016. Effects of organic manure on the growth parameters and yield of okra in Anyigba, Kogi State, North Central, Nigeria. J. Agric. Sci. Eng., 2: 24-30.
26. Okunomo, K., U.N. Ureigho and H.O. Opute, 2006. The effect of soil amendment on the performance of *Gambaya albida* (Linn) seedlings. Agric. J., 1: 262-265.