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Original Article

Evaluation of growth and yield traits of lettuce treated with different organic manures in Kuru-Jos, Nigeria

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ABSTRACT

Lettuce (*Lactuca sativa* L.) is an annual plant of the daisy family, Asteraceae and said to be one of the most important commercial vegetables. An experiment was carried out at the Kwis family garden in Kuru, Jos South Local Government Area of Plateau state to determine the effects of different organic manures on the growth and yield of two varieties of lettuce between April and May 2019. The experiment was laid out in a complete randomized block design with three replicates. Eight kilograms/6 m^2 (20 tonnes/hectare) of organic manure was added on each bed and allowed to decompose for 2 weeks before transplanting. The parameters measured included plant height, leaf length, number of leaves, leaf width, stem girth, root length, and root girth. Results show that significant differences existed between the organic manures and control with respect to plant height, leaf length, leaf width stem girth, root girth, and weight of leaves. The average maximum plant height, leaf length, stem girth, root girth, and weight of leaves was observed with poultry manure while the lowest was the control. There was no significant difference between the organic manures with respect to number of leaves and root length. However, significant differences existed between the two varieties with respect to plant height, leaf length, leaf width, stem girth, root girth, and weight of leaves. The average maximum plant height, number of leaves, and leaf length were observed in variety lettuce Great Lakes. The average maximum leaf width and stem girth were observed in variety lettuce optima. There was no significant difference among the two varieties with respect to weight of leaves, root length, and root girth. Variety lettuce Great Lakes and poultry manure have shown to perform better for most of the parameters and are, therefore, recommended for farmers to use to obtain relatively higher yield.

Keywords: Lettuce, organic manure, Growth and Yield Traits

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INTRODUCTION

Lettuce is one of the most important commercial vegetables. Lettuce (*Lactuca sativa* L.) is an annual plant of the daisy family, Asteraceae. It is most often grown as a leaf vegetable, but sometimes for its stem and seeds. Lettuce is most often used for salads, although it is also seen in other kinds of food, such as soups, sandwiches, and wraps; it can also be grilled.[1] Lettuce was first cultivated by the ancient Egyptians who turned it from a weed whose seeds were used to produce oil, into a food plant grown for its succulent leaves and oil-rich seeds.[2] Lettuce spreads to the Greeks and Romans, the latter of whom gave it the name *lactuca*, from which the English lettuce is ultimately derived. By 50 AD, many types were described, and lettuce appeared often in medieval writings, including several herbals.[2] In addition to its main use as a leafy green, it has also gathered religious and medicinal significance over centuries of human consumption. Europe and North America originally dominated the market for lettuce, but by the late 20th century, the consumption of lettuce had spread throughout the world. World production of lettuce and chicory for calendar year 2015 was 26.1 million tones, 56% of which came from China.[3] Plants generally have a height and spread of 15–30 cm.[4-6] The leaves are colorful, mainly in the green and red color spectrums, with some variegated varieties.[7] There are also a few varieties with yellow, gold, or blue teal leaves.[7,8] Lettuce thrives and grows best in loose, nitrogen-rich soils with a pH of between 6.0 and 6.8.[9,10] Lettuce is a popular vegetable crop used for a variety of dishes in Nigeria. It is a known fact that in almost every occasion, lettuce is never absent. It is used in a variety

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of ways. However, a common dish is the salad.[8] Lettuce is a rich source of Vitamin K and Vitamin A, and a moderate source of folate and iron.

Every day increases the concern with food intake that received excessive chemicals application, since it is known that some chemical molecules when consumed outside the prudential limits cause disease in the short and long term, and vegetable lettuce actually is consumed in natural, steadily increasing consumers' concern with how it is cropped.[8] The use of mineral fertilizers in lettuce growth is a common agricultural practice that brings satisfactory results in terms of yield, however, consumer's health, production cost, and product quality should be considered.[8]

At present, organic manures are used in lettuce production from various sources, which provides a great improvement in both physical and chemical properties of soil thereby reducing needs for mineral fertilizers. Nitrogen content in manure varies with the type of animal and feed ration, amount of litter bedding or soil included, and amount of urine concentrated with the manure.[11] Organic production of vegetables using materials such as manure and compost has been gaining momentum in many regions (Kuntashula *et al*., 2006; Masarirambi *et al*., 2010). Manures are a source of almost all essential nutrients.[12-14] Using manure, the soil organic matter content is increased, thus, the soil structure is progressively improved, reducing its susceptibility to water and wind erosion.[15] As a result of high-energy cost used in production of synthetic fertilizers, these fertilizers have since become fairly expensive. This expensiveness has prompted proper fertilizer management including the use of organic sources such as animal manures and cover crops to save resources.[16]

MATERIALS AND METHODS

This research work was carried out at the Kwis family garden located in Kuru, Jos South Local Government Area of Plateau state (longitude 08° 53`E, latitude 09° 51`N, and altitude 1159 m above sea level). The experiment was carried out between the months of April and May 2019 rainy season. The two different varieties of lettuce seeds used in this research work are variety lettuce Great Lakes and variety lettuce optima. The seeds were obtained from building materials market in Jos South Local Government Area, Plateau state. The experiment was carried out in a complete randomize block design (CRBD). The total number of plots was 24 and total area of the experimental site was 23 m × 11 m (225 m^2). The size of a plot was 3 m × 2 m (6 m^2). The interblock and interplot spaces were 1 m each.

Soil samples were taken from the experimental site using the zigzag method (Brady and Weil, 2007); (four-point determination). The samples were taken to Agricultural Services Training Centre and Marketing Limited laboratory for analysis of phosphorus, potassium, and pH. Similar analysis was performed on the organic manures

The seeds were sown on April 1, 2019, and raised in the plant nursery of Agricultural Services, Training Centre and Marketing Limited, Vom, Plateau state, till after 2 weeks when ready for transplanting.

The experimental land was ploughed several times to obtain a good tilt. The land was leveled, with all weeds, stubbles, and crop residues removed and finally prepared for planting the lettuce seedlings. Eight kilograms/6 m^2 (20 tonnes/hectare) of organic manure was added on each bed according to the allotted treatment and allowed to decompose for 2 weeks before transplanting.[13,14] A 2-week-old lettuce seedlings were transplanted using the necessary tools to minimize shock and ensure that the young plantlets continue growth very quickly. Planting density of 40 seedlings per 6 square meters was used. Each seedling was 8 inches apart from the other.[17] Weeding was carried out every 2 weeks after transplanting (WAT) until the harvest time by handpicking. Destructive sampling was carried out every week after transplanting. Three plants were harvested at random from each plot and used for sampling. Parameters accessed during the work period include plant height, leaf width, leaf length, number of leaves, stem girth, root length, root girth, and weight of leaves.

RESULTS AND DISCUSSION

Results show that significant differences exist between the organic manures and control with respect to plant height, leaf length, leaf width stem girth, root girth, and weight of leaves. There was no significant difference between the organic manures with respect to number of leaves and root length. However, significant differences exist between the two varieties with respect to plant height, leaf length, leaf width, stem girth, root girth, and weight of leaves. There was no significant difference among the two varieties with respect to weight of leaves, root length, and root girth.

Variety lettuce Great Lakes was tallest in height and was significantly ($P < 0.05$) different from variety lettuce optima. There was a significant ($P < 0.05$) difference between the organic manures on mean plant height. Poultry manure showed the highest performance on plant height, followed by pig manure, cow manure, and control in a decreasing order.

There was a significant ($P < 0.05$) difference between the two varieties. Variety lettuce Great Lakes had the highest number of leaves per plant and the lowest was observed in variety lettuce optima. There was no significant difference between poultry manure, cow manure, and pig manure on number of leaves.

Control was significantly different from the three manures and had the lowest number of leaves per plant.

Variety lettuce optima had the highest leaf width and was significantly ($P < 0.05$) different from variety lettuce Great Lakes which had the shortest leaf width. There was a significant ($P < 0.05$) difference between the organic manures on mean leaf width. Pig manure and poultry manure were similar but cow manure was significantly different from control. Pig manure had the highest leaf width which was not significantly ($P < 0.05$) different with poultry manure but significantly ($P < 0.05$) different with cow manure and control (in a decreasing order of performance on leaf width).

Variety lettuce Great Lakes had the longest leaf length and was significantly ($P < 0.05$) different with variety lettuce optima which had the shortest leaf length.

There was a significant ($P < 0.05$) difference between the organic manures on mean leaf length except for pig manure and cow manure which had no significant ($P < 0.05$) difference. Poultry manure had the longest leaf length, followed by pig manure, cow manure, and control.

Variety lettuce optima had the widest stem girth and was significantly ($P < 0.05$) different with variety lettuce Great Lakes.

There was a significant ($P < 0.05$) difference between the organic manures on mean stem girth. Poultry manure had the largest stem girth, followed by pig manure, cow manure, and control.

There was no significant ($P < 0.05$) difference between the two varieties on mean root length. There was no significant ($P < 0.05$) difference between the organic manures on mean root length but control differed ($P < 0.05$) significantly with the organic manures and had the lowest root length. There was no significant ($P < 0.05$) difference between the two varieties on mean root girth.

There was a significant ($P < 0.05$) difference between the organic manures on mean root girth. Poultry manure had the widest root girth, followed by pig manure and cow manure which had no significant ($P < 0.05$) difference and finally control which had the smallest root girth.

Variety lettuce Great Lakes had the highest weight of leaves, which was significantly ($P < 0.05$) different from variety lettuce optima which had the lowest weight of leaves.

There was a significant ($P < 0.05$) difference between the organic manures on mean weight of leaves. Poultry manure had the highest performance on plant height and was significantly different from the other manures. Pig manure and cow manure had no significant difference but control was significantly different from all the treatments and had the lowest performance on weight of leaves.

At 3, 4, and 5 WAT, variety lettuce Great Lakes was significantly ($P < 0.05$) different from variety lettuce optima. Variety lettuce Great Lakes has the longest plant height (18.44 cm) followed by variety lettuce optima (18.44) [Table 1].

There was a significant ($P < 0.05$) difference between the organic manures on mean plant height. At 1, 2, 3, and 4 WAT, poultry manure which showed the highest performance on plant height was significantly different from the other manures, pig manure and cow manure were similar but control was significantly different from all the treatments and had the lowest performance on plant height. At 5 WAT, all the organic manures had significant differences with poultry manure having the highest performance followed by pig manure, cow manure, and control in a decreasing order [Table 1].

At 1, 2, 3, 4, and 5 WAT, there was a significant ($P < 0.05$) difference between the two varieties. Variety lettuce Great Lakes had the highest number of leaves (7.75) and the lowest was observed in variety lettuce optima (6.56). At 4 and 5 WAT, there was no significant difference between poultry manure, cow manure, and pig manure on number of leaves. Control was significantly different from the three manures [Table 2].

Table 1: Effects of variety as affected by different organic manures on mean plant height of lettuce during the 2019 rainy season in Kuru-Jos

Treatments	Plant height (cm) Number of weeks after transplanting				
	1	2	3	4	5
Variety					
Great Lakes	6.55	0.64	12.87^{a}	17.88^{a}	18.44^{a}
Optima	6.61	0.72	11.48^{b}	15.34^{b}	16.99^{b}
LS	NS	NS	*	*	*
L S D	0.18	0.18	0.18	0.18	0.18
Organic manure					
Control	4.65^{c}	5.13^{c}	9.34^{c}	12.89^{c}	12.59^{d}
Poultry manure	9.18^{a}	10.04^{a}	15.87^{a}	20.75^{a}	21.43^{a}
Cow manure	6.14^{b}	6.92^{b}	11.66^{b}	16.34^{b}	16.86^{c}
Pig manure	6.35^{b}	6.98^{b}	11.83^{b}	16.48^{b}	17.07^{b}
LS	*	*	*	*	*
LSD	0.18	0.18	0.18	0.18	0.18
Interaction					
LS	NS	NS	NS	NS	NS

Means followed by the same letter(s) in a column are not significantly different at 5% level of probability (Duncan's new multiple range test)

At 3, 4] and 5 WAT, variety lettuce optima was significantly different from variety lettuce Great Lakes for mean leaf length. At 5 WAT, variety lettuce optima had the highest leaf width (8.78 cm), while variety lettuce Great Lakes had the shortest leaf width (7.49 cm) [Table 3].

Table 2: Effects of variety as affected by different organic manures on mean number of leaves of lettuce during the 2019 rainy season in Kuru-Jos

Treatments	Number of weeks after transplanting				
	1	2	3	4	5
Variety					
Great Lakes	4.67[a]	5.42[a]	6.92[a]	7.67[a]	7.75[a]
Optima	3.67[b]	4.1[b]	5.67[b]	6.47[b]	6.56[b]
LS	*	*	*	*	*
LSD	0.26	0.26	0.26	0.26	0.26
Organic manure					
Control	4.00[b]	4.50[c]	5.34[c]	6.50[b]	6.62[b]
Poultry manure	4.00[b]	4.67[b]	6.34[b]	7.23[a]	7.34[a]
Cow manure	4.17[b]	4.83[b]	6.34[b]	7.17[a]	7.23[a]
Pig manure	4.50[a]	5.17[a]	7.17[a]	7.39[a]	7.45[a]
LS	*	**	**	*	*
LSD	0.26	0.26	0.26	0.26	0.26
Interaction					
LS	NS	NS	NS	NS	NS

Means followed by the same letter(s) in a column are not significantly different at 5% level of probability (Duncan's new multiple range test)

Table 3: Effect of varieties as affected by different types of organic manures on mean leaf width during the 2019 rainy season in Kuru-Jos

Treatments	Leaf width (cm) Number of weeks after transplanting				
	1	2	3	4	5
Variety					
Great Lakes	2.58	3.21	5.24[b]	7.20[b]	7.49[b]
Optima	2.77	3.38	5.94[a]	8.58[a]	8.78[a]
LS	NS	NS	*	*	*
LSD	0.50	0.50	0.50	0.50	0.50
Organic manure					
Control	2.18[b]	2.72[c]	4.35[b]	6.00[c]	6.26[c]
Poultry manure	2.82[a]	4.07[a]	6.53[a]	8.85[a]	9.11[a]
Cow manure	2.39[a]	3.02[bc]	5.42[b]	7.75[b]	7.96[b]
Pig manure	2.43[a]	3.39[b]	6.39[a]	8.95[a]	9.24[a]
LS	*	*	*	*	*
LSD	0.50	0.50	0.50	0.50	0.50
Interaction					
LS	NS	NS	NS	NS	NS

Means followed by the same letter(s) in a column are not significantly different at 5% level of probability (Duncan's new multiple range test)

There was a significant ($P < 0.05$) difference between the organic manures on mean leaf width. At 3, 4, and 5 WAT, pig manure and poultry manure were similar but cow manure was significantly different from control. Pig manure (9.24 cm) and cow manure (9.11 cm) had the highest leaf width followed by cow manure (7.96 cm) and control (6.26) which had the lowest leaf width [Table 3].

At 1, 2, 3, 4, and 5 WAT, there was a significant ($P < 0.05$) difference between the two varieties. At 1 WAT, variety lettuce optima performed better than variety lettuce Great Lakes on mean length of leaf. At 2, 3, 4, and 5 WAT, variety lettuce Great Lakes had the longest leaf length (16.39 cm) and variety lettuce optima had the shortest leaf length (49.94 cm) [Table 4].

There was a significant ($P < 0.05$) difference between the organic manures on mean leaf length. At 1, 2, 3, 4, and 5 WAT, pig manure and cow manure were similar but significantly different from poultry manure and control. Poultry manure had the longest leaf length (19.37 cm) followed by pig manure (15.10 cm) and cow manure (14.80 cm) which had no significant difference. Control had the shortest leaf length (11.63 cm) [Table 4].

At 5 WAT, there was a significant ($P < 0.05$) difference between the two varieties at on mean stem girth with variety lettuce optima having the largest stem girth (2.64 cm) and variety lettuce Great Lakes having the smallest stem girth (2.19 cm), [Table 5].

Table 4: Effect of variety as affected by types of different organic manure on mean leaf length during the 2019 rainy season in Kuru-Jos

Treatments	Leaf length (cm) Number of weeks after transplanting				
	1	2	3	4	5
Variety					
Great Lakes	5.44[b]	6.01[a]	10.91[a]	15.75[a]	16.39[a]
Optima	6.01[a]	5.57[b]	9.48[b]	13.33[b]	14.05[b]
LS	*	*	*	*	*
LSD	0.35	0.35	0.35	0.35	0.35
Organic manure					
Control	3.55[c]	3.82[c]	7.48[c]	11.05[c]	11.63[c]
Poultry manure	8.49[a]	7.82[a]	13.30[a]	18.60[a]	19.37[a]
Cow manure	5.35[b]	5.58[b]	9.85[b]	14.10[b]	14.80[b]
Pig manure	5.52[b]	5.90[b]	10.14[b]	14.40[b]	15.10[b]
LS	*	*	*	*	*
LSD	0.35	0.35	0.35	0.35	0.35
Interaction					
LS	NS	NS	NS	NS	NS

Means followed by the same letter(s) in a column are not significantly different at 5% level of probability (Duncan's new multiple range test)

Table 5: Effect of different varieties as affected by different organic manures on mean stem girth during the 2019 rainy season in Kuru-Jos

Treatments	Stem girth(cm) Number of weeks after transplanting				
	1	2	3	4	5
Variety					
Great Lakes	0.63	0.75	1.36	1.93	2.19[b]
Optima	0.75	0.84	1.48	2.10	2.64[a]
LS	NS	NS	NS	NS	*
LSD	0.25	0.25	0.25	0.25	0.25
Organic manure					
Control	0.50[b]	0.55[c]	0.85[d]	1.20[c]	1.78[d]
Poultry manure	0.98[a]	1.14[a]	1.95[a]	2.70[a]	3.06[a]
Cow manure	0.63[b]	0.75[b]	1.45[b]	2.10[b]	2.25[c]
Pig manure	0.64[b]	0.75[b]	1.48[b]	2.13[b]	2.59[b]
LS	*	*	*	*	*
LSD	0.25	0.25	0.25	0.25	0.25
Interaction					
LS	NS	NS	NS	NS	NS

Means followed by the same letter(s) in a column are not significantly different at 5% level of probability (Duncan's new multiple range test)

Table 6: Effects of variety as affected by different types of organic manure on mean length of lettuce during 2019 rainy season in Kuru-Jos

Treatments	Root length (cm) Number of weeks after transplanting				
	1	2	3	4	5
Variety					
Great Lakes	1.64	2.08	3.74	5.25	5.50
Optima	1.82	2.17	3.80	5.40	5.73
LS	NS	NS	NS	NS	NS
LSD	0.26	0.26	0.26	0.26	0.26
Organic manure					
Control	1.35b	1.75[b]	2.64[c]	3.50[b]	3.87[b]
Poultry manure	2.54[a]	2.92[a]	4.54[a]	6.10[a]	6.32[a]
Cow manure	1.52[b]	1.90[b]	3.90[b]	5.85[a]	6.10[a]
Pig manure	1.52[b]	1.92[b]	4.00[b]	5.85[a]	6.22[a]
LS	*	*	*	*	*
LSD	0.26	0.26	0.26	0.26	0.26
Interaction					
LS	NS	NS	NS	NS	NS

Means followed by the same letter(s) in a column are not significantly different at 5% level of probability (Duncan's new multiple range test)

There was a significant ($P < 0.05$) difference between the organic manures on mean stem girth. Cow manure and pig manure were similar at 1, 2, 3, and 4 WAT but differed at 5 WAT. Poultry manure had the largest stem girth (3.06 cm), followed by pig manure (2.59 cm), cow manure (2.25), and control (1.78 cm) in a decreasing order [Table 5].

At 1, 2, 3, 4, and 5 WAT, there was no significant ($P < 0.05$) difference between the two varieties on mean root length [Table 6].

There was no significant ($P < 0.05$) difference between the organic manures on mean root length but control differed from the organic manures. At 5 WAT, poultry manure (6.32 cm), pig manure (6.22), and cow manure (6.10) which showed no significant difference had the longest root length. Control had the lowest root length (3.87 cm) [Table 6].

At 1, 2, 3, 4, and 5 WAT, there was no significant ($P < 0.05$) difference between the two varieties on mean root girth [Table 7].

There was a significant ($P < 0.05$) difference between the organic manures on mean leaf length. At 1, 2, 3, 4, and 5 WAT, pig manure and cow manure were similar but significantly different from poultry manure and control. Poultry manure had the longest root girth (19.37 cm) followed by pig manure (2.18 cm) and cow manure (2.18 cm) which had no significant difference. Control had the smallest root girth (1.24 cm) [Table 7].

Table 7: Effect of variety as affected by different types of organic manure on mean root girth of lettuce during the 2019 rainy season in Jos

Treatments	Root girth (cm) Number of weeks after transplanting				
	1	2	3	4	5
Variety					
Great Lakes	0.52	0.64	1.05	1.72	2.01
Optima	0.62	0.72	1.17	1.82	2.08
LS	NS	NS	NS	NS	NS
LSD	0.23	0.23	0.23	0.23	0.23
Organic manure					
Control	0.38[b]	0.47[b]	0.63[c]	0.97[c]	1.24[c]
Poultry manure	0.87[a]	1.15[a]	1.57[a]	2.38[a]	2.60[a]
Cow manure	0.50[b]	0.62[b]	1.15[b]	1.89[b]	2.18[b]
Pig manure	0.52[b]	0.62[b]	1.09[b]	1.85[b]	2.18[b]
LS	*	*	*	*	*
LSD	0.23	0.23	0.23	0.23	0.23
Interaction Variety x manure					
LS	NS	NS	NS	NS	NS

Means followed by the same letter(s) in a column are not significantly different at 5% level of probability (Duncan's new multiple range test)

Table 8 shows the effect of variety as affected by different organic manures on mean weight of leaves. Variety lettuce Great Lakes had the highest weight of leaves (33.96 g), which

Table 8: Effects of variety as affected by different types of organic manure on weight of lettuce during 2019 rainy season in Kuru-Jos

Treatments	Weight of leaves (g) Number of weeks				
	1	2	3	4	5
Variety					
Great Lakes	1.25	2.75	16.63[a]	30.85[a]	33.96[a]
Optima	1.22	2.55	15.05[b]	29.41[b]	33.11[b]
LS	NS	NS	*	*	*
LSD	0.82	0.82	0.82	0.82	0.82
Organic manure					
Control	0.54[b]	1.29[b]	4.21[b]	6.97[c]	8.02[c]
Poultry manure	1.55[a]	3.41[a]	23.37[a]	47.80[a]	50.29[a]
Cow manure	1.39[a]	2.71[a]	17.51[b]	32.50[b]	37.66[b]
Pig manure	1.45[a]	3.19[a]	18.28[b]	33.25[b]	38.15[b]
LS	*	*	*	*	*
LSD	0.82	0.82	0.82	0.82	0.82
Interaction					
LS	NS	NS	NS	NS	NS

Means followed by the same letter(s) in a column and row are not significantly different at 5% level of probability (Duncan's new multiple range test)

was significantly ($P < 0.05$) different from variety lettuce optima (33.11 g). There was a significant difference between the two varieties at 3, 4, and 5 WAT.

There was a significant ($P < 0.05$) difference between the organic manures on mean weight of leaves. At 4 and 5 WAT, poultry manure which showed the highest performance on plant height was significantly different from the other manures, pig manure and cow manure were similar but control was significantly different from all the treatments and had the lowest performance on weight of leaves [Table 8].

Different organic manures had varying effects on the growth and yield of two varieties of lettuce. Significant difference was observed among the two varieties with respect to plant height, number of leaves, leaf length, leaf width, weight of leaves, and stem girth. Variety lettuce Great Lakes had better performance for most of the parameters than variety lettuce optima. Reference Jilani *et al*.[18] observed that different varieties perform differently under the same environmental conditions. References Jilani *et al*., Jilani and Ghaffor[18,19] have also suggested that different varieties may have different morphological and biochemical characteristics that affect the biomass accumulation among different vegetative parts. This agrees with the differences as observed in the performance of the two varieties. Significant differences were observed in the general performance of organic manures on the two varieties of lettuce with respect to plant height, leaf length, leaf width, stem girth, and weight of leaves. Poultry manure had better performance for most of the parameters followed by pig manure, cow manure, and finally control in a decreasing order of performance. The chemical analysis reveals that poultry manure had higher concentrations of the nutrients required for growth and development than is observed for the pig and cow manures. This may have been responsible for the significant differences observed. These differences may be due to the availability of nutrients as affected by the water holding capacity of the soil.[20] Recently, higher yields of lettuce "Veneza Roxa" were reported with poultry manure followed by cattle manure and finally inorganic fertilizer.[13] Increased vegetable yield with the use of organic manures has been reported for Okra.[15]

These results are in agreement with work done in Brazil where chicken manure, compost, charcoal, forest litter, and chemical fertilizer 2:3:2(22) were tested during four cropping cycles with rice (*Oryza sativa* L.) and sorghum (*Sorghum bicolor* L.) in five replicates in which the application of chicken manure amendments resulted in the highest cumulative yield.[21] On the contrary, a study was conducted to determine the effects of applying organic fertilizers and inorganic fertilizers on the yield and nutritive value of head lettuce, equivalent yields were obtained regardless of the type of fertilizer used.[22] In another studies with tomato, results showed that two organic fertilizer treatments provided better yield than chemical fertilizers.[23]

CONCLUSION

In this research, variety lettuce Great Lakes has shown to perform better than variety lettuce optima for most of the parameters. Poultry manure has shown to increase plant height, number of leaves, leaf width, leaf length, stem girth, root girth, and weight of leaves. Variety lettuce Great Lakes and poultry manure are, therefore, recommended for farmers to use to obtain relatively higher yield. It is recommended that more research be conducted across different locations with varied ecology to validate the recommendations.

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