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GROWTH RESPONSE OF LETTUCE (*Lactuca sativa L.*) TO IRRIGATION INTERVALS AND COW DUNG RATES IN MAIDUGURI, SUDAN SAVANNA, NIGERIA

***MARYAM IBRAHIM UMAR[1] AND ZANNA ABBA KURA[1]**

[1]*Department of Agricultural Technology Mohamet Lawan College of Agriculture Maiduguri, Borno State, Nigeria*

ABSTRACT

Field experiments were conducted during 2014/15 and 2015/16 cool harmattan dry seasons at Teaching and Research Farm of the Department of Crop Production, University of Maiduguri (Latitude 11.808 and Longitude 13.199), 323m above sea level in Sudan Savana, Maiduguri, Borno State. This was aimed to study the growth response of lettuce to irrigation intervals and cow dung rates

Introduction

Lettuce (*Lactuca sativa L.*) belongs to the family Asteraceae and is believed to have originated in Asia or North Africa (Vernon, 1999). It is the first cultivated salad crop and commercialized internationally (Abu-Rayyan *et al.*, 2004). It is the most popular vegetable according to the highest consumption rate and economic importance throughout the world (Coelho *et al.*, 2005). Lettuce is a vegetable which is grown under cool temperature on fertile and well drained soils, and responds very well to the application of manure. Leafy lettuce types have been cultivated since at least the time of the ancient Greeks 2500 years ago, and different types were subsequently developed by the Moors (Valenzuela *et al.*, 1996). There are several varieties of lettuce popular among which are Butter-head, Chinese crisp head, Loose-leaf, Romaine/Cos-lettuce, Summer crisp, Stem and Oil seed. The butter-head and crisp head are sometimes known together as "Cabbage-

lettuce", because their heads are shorter, flatter and more cabbage-like than Romaine lettuce (Rhodes, 2004). The major distinguishing features among varieties are the bunch arrangement, leaf shape and texture. *Lactuca sativa* is a small size annual plant that flourishes in well-drained, humus soil. The plant has a shallow root system with a root mass extending 1ft into the soil (Valenzuela *et al.*, 1996). The plants generally have a height and spread of 15-30cm (Ogbodo *et al.*, 2010). The leaves are colourful, mainly in green and red color spectrums with some variegated varieties. There are also a few varieties with yellow, gold or blue-teal leaves. Lettuce plants have a wide range of shapes and textures,

in Maiduguri. The treatments consisted of a factorial combinations of five irrigation intervals (2, 3, 4, 5, and 6 days) and six rates of cow dung (0, 10, 15, 20, 25, and 30t/ha) laid out in a split plot design and replicated three times. Irrigation intervals were assigned to the main plots while cow dung rates were assigned to the sub plots during the two trials. The growth parameters measured were: plant height (cm), number of leaves per plant, leaf area per plant (cm) and leaf whorl diameter (cm). Correlation coefficient analysis was carried out to determine the relationship among parameters measured. The results showed that 5 days irrigation interval was optimum for plant height, number of leaves, leaf area per plant and leaf whorl diameter for both seasons and the combined mean at all stages of sampling. The application of 30t/ha of cow dung gave significantly higher values for all the growth components of the lettuce in both the years and combined mean except for number of leaves per plant. The application of 25t/ha cow dung was found to be optimum for the number of leaves per plant in both the years and the combined mean. Based on the results of the present study, the growing of lettuce using the combinations of 6 days irrigation intervals with 30t/ha of cow dung during the cool harmattan periods in Maiduguri is more economical and therefore, encouraged.

KEYWORDS: *Cool, Harmattan, Lettuce, Irrigation interval, Cow dungs rate*

from the dense heads of the iceberg type to the notched, scalloped, frilly leaf varieties (Norman, 1992).

Low content of organic manure in the dry zone soil critically affects the crop yield. To obtain sufficient yield of vegetable crops, particularly lettuce, adequate supply of nutrient elements like N, P, and K is necessary, and manure is a valuable source of these nutrients. The use of organic matter such as animal manures, human waste, sewage sludge and compost has long been recognized in agriculture as beneficial for plant growth and yield and the maintenance of soil fertility. Despite the importance of lettuce as a vegetable, there is dearth of information pertaining to its cultivation using locally available resources such as organic manures. Lettuce is also known to be grown during the cool-dry harmattan season at the study area. Its yield during this period is limited by soil moisture stress caused by high rate of evapotranspiration and low water holding capacity of the sandy semi-arid soil (Rayar 1984). Higher frequency of irrigation could be used to alleviate soil moisture stress and increase lettuce yields, however, the acute shortage of irrigation water in this region necessitates its economy (Adetunji, 1990). Thus, the need to develop the most economic and suitable irrigation interval for such crop.

The present study is therefore designed to determine growth components of lettuce when fertilized with cow dung rates under varied irrigation intervals. The objectives of the study were to determine the effect of irrigation interval on growth components of lettuce in the semi-arid environment of Maiduguri and to determine effect of different rates of cow dung manure on growth components of lettuce in the semi-arid environment of Maiduguri.

MATERIALS AND METHODS

Description of Experimental Site

The trials reported here were conducted at the Teaching and Research Farm of the Department of Crop Production, Faculty of Agriculture University of Maiduguri (Latitude 11.808 and Longitude 13.199, and 323m above sea level) during the cool dry seasons of 2014/2015 and 2015/2016. Maiduguri is located in the Sudan Savannah with average peak daily temperature ranging between 34°c and 40°c especially in April and May.

The rainy season last from June to September (GSN 1994; Musa and Pindar, 2005). The site was previously cropped to groundnuts.

Treatments and experimental design

The experiment was a factorial combination consisting of six cow dung rates (0,10,15,20,25, and 30t/ha) and five irrigation intervals (2,3,4,5, and 6 days). The experiment was laid out in a split-plot design with three replications. Irrigation intervals was allocated to the main plots and Cow Dung rates to the sub-plots. The experimental field covered a total area of 456m^2 (12m length and 38m breadth). The main plots size was 144m^2 (12m x 12m), sub plots size was 4m^2 (2m x 2m) and net plots size was 1m^2 each. The main plot alley and sub plot alley was 1m and 0.5m apart. Inter row and intra row spacing was 20cm x 20cm respectively. Details of field layout and experimental design are presented in Figure 1.

Meteorological Data

Data on temperature, relative humidity and wind velocity covering the period of the study for both seasons was obtained from the meteorological unit of Federal Ministry of Aviation, Maiduguri.

Soil and Cow dung Analysis

At land preparations, composite soil samples were taken diagonally from experimental site at 0-20cm and 20-40cm depths for the two seasons. The samples were mixed thoroughly in a container after which a representative sample was scooped out from the bulk and analyzed for physico-chemical properties at the Soil Science Laboratory, University of Maiduguri.

Well decomposed Cow dung was obtained from the Livestock farm at the University of Maiduguri. A sample was scooped and taken to the Soil Science Laboratory, University of Maiduguri to analyse its chemical properties.

Experimental Materials

Description and source of crop variety used: The lettuce cultivar "Loose-Leaf" seeds was obtained from the Horticultural Unit of Borno State Agricultural Development Program (BOSADP) Maiduguri. This cultivar is

quite popular grown by farmers in Northern Nigeria. It has loosely bunched leaves and is the most widely planted by farmers within Maiduguri. It features tender, delicate leaves with loose bunch. Leaves are broad with leaf margins that may be entirely lobed or frilled. They are generally upright but can also be flattened.

Cultural practices

Land preparation: The experimental site was cleared and harrowed. The land was properly levelled and the beds marked out according to specification. The edges of each beds were raised to prevent run-off during irrigation. The beds were then thoroughly watered for three days before transplanting.

Cow dung application: The cow dung treatment rates were applied and incorporated into the soil according to each plot treatments two weeks before transplanting.

Sowing and transplanting: For good germination in the nursery, well tilled seed bed with a fine loose surface was marked out and seed beds were soaked with water before seed sowing. Lettuce seeds were broadcasted on the 6th of October, 2014 in the first year and on 5th October, 2015 for the second trial, on a moist but drained loose soil that is not soggy, free from stones and large clods of dirt then it was covered with 1cm dry grass mulch and watered thrice a week. Hand weeding and watering continued until seedlings were ready for transplanting. The nursery was well watered prior to transplanting to ease up rooting, while the field was watered two hours before transplanting. Seedlings were transplanted on the 3th November, 2014 and 2th November, 2015 after emergence of 3-4 mature leaves and a well developed root system. The inter row and intra row spacing was 20cm x 20cm (Tindall, 1992) respectively.

Weed and insect pest: Being an organic farming, strict hygiene was maintained to reduce the incidence of pests and diseases, since the crop will be raised in a chemical-free environment. Sanitation practices like regular weeding is paramount to deter pest and insect, since most weeds serve as host plants to some harmful insects and pest. Weeding was done by manual method using a hand hoe specially designed for lettuce fields and hand pulling.

Irrigation: During the trial for the two seasons, water was collected from a bore hole into a surface tank and allowed to cool down before using it to irrigate the plants. At transplanting the seedlings, enough water was applied to each plot daily for three days to avoid transplanting shocks. Thereafter, Irrigation continued in respective plots according to the scheduled intervals during evenings.

Data collection

During the two trials, crops were monitored from planting through harvest and parameters on growth components were assessed at every two (2) weeks interval.

Plant height (cm)

Plant height was recorded from the ground level using meter rule to the apex of the plant at 4, 6 WAT and at harvest from 5 randomly selected plants within the net plot. The average plant height was expressed in cm and recorded.

Number of leaves/plant

The number of leaves were counted from the five randomly selected five plants in the net plot and the average value was calculated and recorded as number of leaves per plant at 4, 6 WAT.

Leaf area/plant (cm^2)

Three plants were randomly selected and uprooted for the Leaf Area Measurement. The leaf area was measured using "JP Leaf Area Meter" at 4, and 6 WAT.

Leaf whorl diameter (cm)

This was determined at 4, 6 WAT by selecting three heads at random from net plot and measured using measuring tape during each trial. The average from three heads gave the whorl diameter for each plot.

Data Analysis

The data collected from the experiment was subjected to Analysis of Variance (ANOVA) at 5% level of probability. The difference among the

means was identified using Least Significant Difference (LSD) as reported by Gomez and Gomez (1984).

RESULTS

Meteorological Data of the Experimental Site

Data for mean minimum and maximum temperature, relative humidity and wind velocity for the two seasons are presented in Tables 1. Data on minimum and maximum temperature in Maiduguri during the two seasons experiments is presented in Table 1. In both seasons, the highest minimum and maximum temperature was recorded in November and December respectively. Mean relative humidity from both seasons during the experiments showed increasing trends in percentage as the season advances. Peak relative humidity values were recorded in the month of November. The relative humidity was fairly conducive during vegetative phases of growth. Information on wind velocity for the two seasons is shown in Table 1. Wind velocity is higher in January for the first season and for the second season, highest wind velocity was recorded in the month of November.

Table 1. Minimum and maximum temperature, relative humidity and wind in 2014/15 and 2015/16 seasons

	YEAR	NOVEMBER	DECEMBER	JANUARY
Temperature (°c)	2014/2015			
Maximum		35.70	30.40	30.90
Minimum		19.20	12.80	12.70
Relative humidity (%)		58	37	19
Wind (knots)		34.20	45.90	50.25
Temperature (°c)	2015/2016			
Maximum		38.00	34.00	35.00
Minimum		18.00	18.60	14.80
Relative humidity (%)		29	24	20
Wind (knots)		49.60	30.60	32.78

Source: Federal Ministry of Aviation, Meteorological unit, Maiduguri, Borno state

Table 2. Physical and chemical properties of the soil at the experimental site during 2014/2015 and 2015/2016 cool dry seasons

Soil properties	2014/2015		2015/2016	
	0-20cm	**20-40cm**	**0-20cm**	**20-40cm**
Particle size distribution				
Sand g/kg	722.50	735.00	746.00	721.00
Silt g/kg	162.50	150.00	175.00	200.00
Clay g/kg	115.00	115.00	79.00	79.00
Textural class	Sandy loam	Sandy loam	Sandy loam	Sandy loam
Chemical properties				
pH in water (1:25)	7.9	7.9	7.7	7.4
Organic carbon (g/kg)	4.5	3.1	8.4	7.4
Total nitrogen (g/kg)	1.3	1.1	1.4	0.7
Available P (mg/kg)	17.15	15.05	8.05	4.55
Basic cation (Cmol/kg)				
K^+	0.82	0.91	0.63	0.87
Mg^+	2.60	2.40	3.00	7.20
Ca^+	9.60	12.40	6.20	9.80
Na	0.23	0.26	0.11	0.18
CEC	13.25	15.97	9.94	18.05

Table 3. Chemical properties of the analyzed cow dung used for the experiment

Parameters	Value (%)	
	2014/15	2015/16
N	1.68	1.12
P	0.21	0.26
K	1.95	2.28
Ca^{2+}	2.10	1.10
Mg^{2+}	0.49	0.49

Effects of Irrigation Intervals and Cow Dung Rates on Growth Parameters

Plant Height (cm)

Lettuce plant height as influenced by irrigation intervals and cow dung rates in the year 2014/15 and 2015/16 seasons and its combined mean are shown in Table 4. There were significant effects of the irrigation intervals and cow dung rates on plant height in both years and the combined means. Generally, 5 days irrigation interval gave significantly higher values for plant height in both the years and the combined means at all stages of sampling. Plant height increased significantly with increased application of cow dung at all stages of sampling with the cow dung rate of 30t/ha giving the tallest plants for both seasons and the combined.

Number of Leaves/plant

Table 5 shows the effects of irrigation intervals and cow dung rates on number of leaves per plant of lettuce in the year 2014/15, 2015/16 and combined mean. Generally, irrigation frequency of up to 5 days was optimum for number of leaves in both years and the combined means at all stages of sampling. Number of leaves per plant were significantly higher at the higher rates of cow dung, with the 25t/ha of cow dung, generally being the optimum rate for number of leaves per plant.

Leaf Area/plant (cm^2)

The effects of irrigation intervals and cow dung rates on leaf area per plant of lettuce is shown in table 6. There was significant effect of both irrigation intervals and cow dung rates on leaf area per plant in both the years and the combined means at all stages of sampling.

Generally, the results showed that leaf area statistically increased with increase in irrigation days up to the 5 days interval as its peak where widest leaf area values in both the years and the combined means at all stages of sampling were recorded and thereafter decreased with increase in irrigation intervals in both the years and the combined means at all periods of sampling. Leaf area increased with increase in cow dung application up to the 30t/ha in both years and the combined means at all stages of sampling.

Table 4: Effects of irrigation intervals and cow dung (CD) rates on plant height (cm) of lettuce

	Plant Height (cm)								
Treatments	2014/15			2015/16			Combined mean		
	4 WAT	6 WAT	8 WAT	4 WAT	6 WAT	8 WAT	4 WAT	6 WAT	8 WAT
Irrigation interval (A)									
2 Days	11.69b	15.36b	18.95b	11.45a	15.51b	19.05b	11.57b	15.43b	19.00b
3 Days	11.87b	15.29b	19.18b	11.93a	15.62b	19.48b	11.90b	15.48b	10.33b
4 Days	11.89b	15.66b	19.59b	12.01a	15.87b	19.88b	11.95b	15.76b	19.73b
5 Days	13.96a	18.82a	22.83a	12.34a	18.13a	21.38a	13.15a	18.48a	22.11a
6 Days	11.31b	15.27b	18.67b	11.49a	14.83b	19.01b	11.40b	15.05b	18.84b
SE±	0.3378	0.6366	0.5857	0.3112	0.6102	0.4360	0.3078	0.5738	0.4929
CD (B)									
0.0 t/ha	9.14d	12.95c	16.86de	8.94e	12.89cd	17.12c	9.04d	12.92c	16.99de
10 t/ha	9.64d	11.73c	15.05e	9.64de	11.49d	15.29c	9.64cd	11.61c	15.17e
15 t/ha	11.01c	13.67c	17.20d	10.55d	13.78c	17.33c	10.78c	13.73c	17.27d
20 t/ha	12.48b	17.08b	20.51c	12.14c	17.17b	20.43b	12.31b	17.12b	20.47c
25 t/ha	14.89a	18.57b	23.05b	14.27b	18.90b	22.49b	14.58a	18.73b	22.77b
30 t/ha	15.69a	22.47a	26.40a	15.52a	21.71a	25.91a	15.61a	22.10a	26.15a
SE±	0.4634	0.7472	0.6753	0.4118	0.7501	0.7032	0.4173	0.7181	0.6406
Interaction (AXB)	NS	NS	*	NS	NS	*	NS	NS	*

Means in a column followed by the same letters are not significantly different from each other at P≤0.05 according to DMRT

∗ = Significantly different from each other

NS = Not significantly different from each other

WAT = Weeks after transplant

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Table 5: Effect of irrigation intervals and cow dung (CD) rates on number of leaves/plant on growth of lettuce

	Number of Leaves/plant								
Treatments	2014/15			2015/16			Combined mean		
	4 WAT	6 WAT	8 WAT	4 WAT	6 WAT	8 WAT	4 WAT	6 WAT	8 WAT
Irrigation interval (A)									
2 Days	5.72b	8.73b	12.89b	6.04ab	8.42c	12.78b	5.88b	8.58a	12.84b
3 Days	5.69b	8.73b	12.84b	5.81ab	8.91a	12.92b	5.75b	8.82a	12.88b
4 Days	5.68b	8.79ab	13.19b	6.11a	8.83ab	13.26b	5.90b	8.81a	13.22b
5 Days	6.53a	9.41a	15.74a	5.88ab	8.53bc	12.77a	6.20a	8.97a	15.26a
6 Days	5.50b	8.14b	12.74b	5.69b	8.40c	12.98b	5.59c	8.27a	12.86b
SE±	0.0767	0.1888	0.6924	0.1162	0.1093	0.3284	0.0447	0.1237	0.4948
CD (B)									
0.0 t/ha	5.69cd	7.98c	11.83c	1.54c	8.00c	11.77c	5.62c	7.99c	11.80c
10 t/ha	5.39d	7.93c	12.74bc	5.41c	7.95c	12.61bc	5.40c	7.94c	12.68bc
15 t/ha	5.58cd	8.88b	12.73bc	5.55c	8.51b	12.98b	5.57c	8.70b	12.86b
20 t/ha	5.89bc	9.04b	13.25b	5.92b	8.87ab	13.19b	5.91b	8.95ab	13.22b
25 t/ha	6.13ab	9.53a	14.77a	6.43a	9.17a	14.59a	6.28a	9.35a	14.68a
30 t/ha	6.26a	9.21ab	15.55a	6.59a	9.21a	14.90a	6.43a	9.21a	15.22a
SE±	0.1101	0.1625	0.4152	0.1180	0.1418	0.3357	0.0879	0.1393	0.4948
Interaction(AXB)	NS	NS	NS	*	NS	NS	*	NS	NS

Means in a column followed by the same letters are not significantly different from each other at P≤0.05 according to DMRT

∗ = Significantly different from each other

NS = Not significantly different from each other

WAT = Weeks after transplant

Table 6: Effects of irrigation intervals and cow dung (CD) rates on leaf area/plant (cm²) of lettuce

	Leaf area (cm^2)								
Treatments	2014/15			2015/16			Combined mean		
	4 WAT	6 WAT	8 WAT	4 WAT	6 WAT	8 WAT	4 WAT	6 WAT	8 WAT
Irrigation interval (A)									
2 days	53.74ab	83.77b	93.75b	52.52a	83.91b	95.26b	48.32b	83.84c	94.51b
3 days	53.47ab	86.96b	94.58b	52.28a	84.01b	94.44b	52.88ab	85.49bc	94.51b
4 days	52.49b	91.07ab	102.09ab	50.76a	88.72ab	101.46b	53.13a	89.90ab	101.77ab
5 days	58.47a	96.43a	105.06a	48.27a	93.89a	111.11a	53.37a	95.16a	108.09a
6 days	46.30c	83.91b	93.94b	48.56a	84.13b	98.64b	47.43b	84.02bc	96.29b
SE±	1.6441	2.5958	2.4957	1.4536	1.7353	2.3143	1.4160	1.7479	2.1410
CD rates (B)									
0.0 t/ha	30.35d	79.49b	75.05c	27.13e	67.95e	75.49e	28.74d	73.72d	75.27d
10 t/ha	41.70c	81.62b	74.16c	34.93d	74.19d	79.13de	38.31c	77.90cd	76.64d
15 t/ha	42.89c	83.67b	74.96c	40.43d	78.74cd	83.86cd	41.66c	81.20c	79.41d
20 t/ha	58.79b	85.24b	83.09c	57.39c	83.12c	89.64c	58.09b	84.18bc	86.37c

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25 t/ha	70.65a	88.97b	130.48b	67.81b	93.81b	119.79b	69.23a	91.39b	125.14b
30 t/ha	72.98a	111.57a	149.57a	75.13a	123.79a	153.19a	74.08a	117.68a	151.38a
SE±	2.6171	4.0985	3.1121	1.8662	1.6611	2.2202	2.0488	2.4776	2.3288
Interaction(A*B)	NS	*	*	*	*	*	*	*	*

Means in a column followed by the same letters are not significantly different from each other at P≤0.05 according to DMRT

* = Significantly different from each other

NS = Not significantly different from each other

WAT = Weeks after transplant

Leaf Whorl Diameter (cm)

Lettuce leaf whorl diameter as influenced by irrigation intervals and cow dung rates in 2014/2015, 2015/2016 seasons and the combined means are presented in Table 7. There was significant effect of irrigation intervals on leaf whorl diameter in the year both years and the combined mean. Generally, irrigation interval of 5 days was optimum for the leaf whorl diameter in both the years and the combined mean. A trend of superiority of different rates of cow dung application was observed as lettuce provided with the highest rate of cow dung exhibiting higher values for leaf whorl diameter in both the years and the combined mean at all stages of sampling.

Table 7: Effects of irrigation intervals and cow dung (CD) rates on leaf whorl diameter (cm) of lettuce at 4, 6, and 8 weeks after transplant (WAT)

Treatments	2014/2015			2015/2016			Combined mean		
	4	6	8	4	6	8	4	6	8
Irrigation interval (A)									
2 Days	10.61a	14.32a	17.73bc	10.57d	14.71bc	17.60c	10.59c	14.51ab	17.67b
3 Days	10.53a	13.96ab	18.15ab	11.41c	14.33c	18.21bc	10.97bc	14.15ab	18.18b
4 Days	10.49a	13.61ab	17.16c	11.80c	14.34c	17.83c	11.14bc	13.99b	17.49b
5 Days	10.24a	13.31b	18.92a	13.48a	16.34a	19.41a	11.48ab	14.82a	19.16a
6 Days	10.30a	13.81ab	17.34bc	12.72b	15.49b	19.13ab	11.39a	14.65b	18.24ab
SE±	0.2407	0.2393	0.2874	0.2155	0.2366	0.3343	0.1706	0.2083	0.2841
CD (B)									
0.0 t/ha	8.91d	11.56e	15.41e	10.27d	13.23e	15.83e	9.59e	12.40e	15.62e
10 t/ha	8.96d	12.54d	16.65d	11.20c	14.16d	16.95d	10.08de	13.35d	16.80d
15 t/ha	9.35d	12.81d	17.13d	11.43c	14.52cd	17.82c	10.40d	13.67d	17.48c

20 t/ha	10.75c	14.51c	18.44c	12.22b	15.23bc	19.37b	11.48c	14.87c	18.90b
25 t/ha	11.87b	15.21b	19.33b	12.75b	15.72b	19.45b	12.31b	15.47b	19.39b
30 t/ha	12.78a	16.19a	20.20a	14.06a	17.39a	20.20a	13.42a	16.79a	20.70a
SE±	0.2235	0.2160	0.2325	0.2560	0.2891	0.2734	0.1760	0.1880	0.1770
Interaction(AXB)	NS	**	**	**	**	**	*	**	**

Means in a column followed by the same letters are not significantly different from each other at 5% level of probability according to DMRT
$*$ = Significantly different from each other
NS = Not significantly different from each other
WAT = Weeks after transplant

Conclusion

From the results of the present study, it could be concluded that;

1. The application of 30t/ha of cow dung in Maiduguri, Sudan Savanna of Nigeria gave the optimum growth (in terms of quality and wider leave area) of Lettuce.
2. Combination of 6 days irrigation interval with the application of 30t/ha of cow dung was the best for lettuce production during the cool harmattan season in the Maiduguri semi-arid environment in terms of yield.
3. Six days irrigation interval combined with 30t/ha of cow dung had higher returns in terms of monetary advantage.

Recommendations

From the results of the present study, it could be recommended that;

1. Farmers should grow lettuce using 6 days irrigation interval combined with 30t/ha of cow dung to get maximum yield and have greater monetary return from growing lettuce.
2. Farmers could use wider irrigation intervals during the cool harmattan periods in Maiduguri.
3. The application of 30t/ha of cow dung in Maiduguri in Sudan Savanna of Nigeria gave greater monetary return from growing lettuce.
4. Further research with irrigation intervals wider than 6 days and cow dung rates above 30t/ha could prove useful and also to

evaluate the interactions of the temperature levels and irrigation intervals should be pursued to enrich knowledge.

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