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YIELD AND MONETARY ADVANTAGE OF LETTUCE (*Lactuca sativa L.*) AS AFFECTED BY COW DUNG RATES AND IRRIGATION INTERVALS IN MAIDUGURI, SUDAN SAVANNA, NIGERIA

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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 yield and monetary

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,

advantage of lettuce as affected by cow dung rates and irrigation intervals 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 yield and yield components parameters measured were: root fresh weight (g/plant), dry root weight (g/plant), shoot fresh weight (g/plant), shoot dry weight (g/plant) and shoot yield (kg/ha). The monetary advantage of growing lettuce under different irrigation intervals and cow dung rates were also determined. The results showed that 5 days irrigation interval was optimum for shoot fresh weight, shoot dry weight, fresh root weight, root dry weight, shoot yield and monetary advantage 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 yield, yield components and monetary advantage of the lettuce in both the years and 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

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, 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 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 yield and yield components of lettuce when fertilized with cow dung rates under varied irrigation intervals. The objectives of the study were to determine the effects cow dung rates and irrigation intervals on yield and yield components of lettuce in the semi-arid environment of Maiduguri and to determine effect of different rates of cow dung and monetary advantage 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.

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 analysed 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.

Fresh weight of root/plant (g)

The fresh weight of three roots selected randomly at 4, 6 WAT and at harvest were weighed using a Sensitive Electronic Balance, and were recorded, and the average fresh weight of root was expressed in g/plant.

Dry weight of root/plant (g)

The roots from the three randomly selected plants in each treatment was sun dried to a constant weight achieved and the dry weight was recorded. The average dry weight of root was expressed in g/plant.

Fresh weight of shoot/plant (g)

The shoot from the three randomly selected plants were weighed and the average value was obtained as shoot weight per plant at 4, 6 WAT and at harvest.

Dry weight of shoot/plant (g)

The shoots from the three randomly selected plants in each treatment were sun dried to a constant weight and the dry weight recorded. The average dry weight of shoot was expressed in g/plant.

Shoot yield (kg/ha)

This was taken from net plots by weighing the total above ground dry matter produced within each plot at harvest and the value obtained was converted to kg/ha. A sensitive electronic balance was used.

Data Analysis

Analysis of Variance

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).

Monetary Advantage

Economic analysis was carried out to determine the Gross margin of lettuce production under various rates of cow dung, irrigation interval and total revenue. The total cost of production from nursery raising to harvesting was calculated and net profit were determined according to price per hectare of lettuce in Maiduguri as proposed by Okoruwa *et al.* (2005), using the mathematical expression:

$GM = TR - VC$

Where:

GM= Gross margin (ha^{-1})

TR= Total revenue (₦)

VC= Variable cost (₦)

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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 **Minimum**		35.70 19.20	30.40 12.80	30.90 12.70
Relative humidity (%)		58	37	19
Wind (knots)		34.20	45.90	50.25
Temperature (°c)	2015/2016			

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Maximum **Minimum**		38.00 18.00	34.00 18.60	35.00 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		

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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 Yield and Yield Components

Fresh weight of shoot /plant (g)

Effects of irrigation intervals and cow dung rates on fresh weight of shoot per plant of lettuce during the two trials are presented in Table 4. Fresh weights of shoot per plant at 4 WAT were heavier at a closer irrigation intervals, but from 6 WAT, 5 days irrigation interval was optimum for this parameter for both the seasons and the combined means. Application of cow dung significantly influenced lettuce fresh weight per plant in both seasons and the combined mean. Cow dung of 30t/ha significantly produced heavier fresh weight of shoot per plant at harvest of the two seasons and the combined mean of the two trials. There was significant interaction of irrigation intervals and cow dung rates on fresh weight of shoot per plant (Table 4).

Dry weight of shoot (g) per plant

The effects of irrigation intervals and cow dung rates on dry weight of shoot per plant of lettuce for the two seasons is shown in Table 5. The treatments had significant effects on the shoot dry weight per plant at 6 and 8 WAT in both the seasons and at all stages of measurement. The irrigation interval of 5 days was optimum for the dry weight of shoot per plant for both seasons and the combined mean at all stages of sampling. Cow dung rates on the other hand played a role in the increase dry weight of shoot per plant of lettuce. As the cow dung rates were increased, the weight of the shoot per plant also increased significantly and till it reached the highest the maximum rate of cow dung used (30t/ha) in all the seasons and the combined mean at all stages of measurement.

Fresh weight of root/plant (g)

The effects of irrigation intervals and cow dung rates on fresh weight of root per plant of lettuce in the years 2014/2015, 2015/2016 seasons and the combined means are shown in Table 6. There was significant effects of irrigation intervals on fresh weight of root per plant of lettuce in both seasons and the combined mean. Generally, 5 day irrigation interval was the optimum for fresh weight of root per plant in both seasons and the combined mean at all periods of sampling. Application of cow dung significantly influenced lettuce fresh weight of root per plant in both seasons and the combined mean. Cow dung rate of 30t/ha significantly produced heavier fresh weight of root per plant in both seasons and the combined mean with zero cow dung giving the least value.

Table 4: Effects of irrigation intervals and cow dung (CD) rates on fresh weight of shoot/plant (g) of lettuce at 4, 6, and 8 weeks after transplant (WAT)

	Fresh weight of shoot per plant (g)								
Treatments	2014/2015			2015/2016			Combined mean		
	4	6	8	4	6	8	4	6	8

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Irrigation interval (A) (Days)									
2	11.32^{a}	15.50^{b}	18.27^{ab}	11.39^{ab}	15.42^{b}	18.33^{b}	11.36^{ab}	15.46^{b}	18.30^{ab}
3	11.53^{a}	15.46^{b}	18.71^{ab}	11.56^{a}	15.74^{b}	18.80^{ab}	11.55^{a}	15.60^{b}	18.76^{ab}
4	10.76^{b}	14.89^{b}	18.69^{ab}	10.06^{abc}	15.14^{b}	18.69^{ab}	10.91^{bc}	15.02^{b}	18.69^{ab}
5	10.60^{b}	16.76^{a}	19.03^{a}	10.51^{c}	16.81^{a}	20.06^{a}	10.56^{c}	16.79^{a}	19.57^{a}
6	10.38^{b}	13.59^{c}	17.37^{b}	10.82^{bc}	13.94^{c}	17.68^{b}	10.60^{c}	13.77^{c}	17.53^{b}
SE±	0.1500	0.3210	0.419^{6}	0.1937	0.2708	0.4559	0.1589	0.2650	0.4360
CD (B)									
0.0	7.57^{d}	11.37^{d}	14.11^{e}	7.69^{e}	11.54^{d}	13.31^{e}	7.63^{e}	11.46^{d}	14.21^{e}
10	7.77^{d}	11.73^{d}	14.63^{de}	7.95^{e}	11.85^{d}	14.33^{de}	7.86^{de}	11.79^{d}	14.78^{de}
15	8.25^{d}	12.38^{d}	15.67^{d}	8.63^{d}	12.55^{d}	15.46^{d}	8.44^{d}	12.47^{d}	15.77^{d}
20	10.14^{c}	13.79^{c}	16.80^{c}	10.42^{c}	14.21^{c}	17.12^{c}	10.28^{c}	14.00^{c}	16.96^{c}
25	13.75^{b}	18.59^{b}	21.75^{b}	13.69^{b}	18.77^{b}	22.22^{b}	13.72^{b}	18.68^{b}	21.98^{b}
30	18.03^{a}	23.57^{a}	27.59^{a}	18.02^{a}	23.55^{a}	27.83^{a}	18.03^{a}	23.56^{a}	27.71^{a}
SE±	0.2558	0.4213	0.3538	0.1872	0.3842	0.3526	0.2101	0.3782	0.3391
Interaction (AXB)	**	**	**	**	**	**	**	**	**

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

∗ ∗ = Significant at 1% Level of probability

NS = Not significant

WAT = Weeks after transplant

Table 5: Effects of irrigation intervals and cow dung (CD) rates on dry weight of shoot/plant (g) of lettuce at 4, 6, and 8 weeks after transplant (WAT)

	Dry weight of shoot per plant (g)								
Treatments	2014/2015			2015/2016			Combined mean		
	4	6	8	4	6	8	4	6	8
Irrigation interval (A) (Days)									

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2	5.52^{a}	8.26^{b}	9.27^{b}	5.38^{a}	8.26^{b}	9.54^{ab}	5.45^{a}	8.26^{b}	9.06^{b}
3	5.45^{a}	8.32^{b}	9.69^{b}	5.36^{a}	8.32^{b}	9.33^{ab}	5.40^{a}	8.32^{b}	9.51^{b}
4	5.38^{a}	8.31^{b}	9.62^{b}	5.29^{a}	8.42^{b}	9.55^{ab}	5.34^{a}	8.36^{b}	9.62^{ab}
5	5.04^{a}	11.58^{a}	11.13^{a}	4.94^{a}	9.84^{a}	10.78^{a}	4.99^{a}	10.21^{a}	10.96^{a}
6	5.44^{a}	8.58^{b}	9.70^{b}	5.34^{a}	8.36^{b}	8.84^{b}	5.39^{a}	8.47^{b}	9.58^{b}
SE±	0.2439	0.2734	0.3383	0.3220	0.2858	0.5078	0.2756	0.2726	0.3971
CD (B)									
0.0	3.80^{d}	6.12^{e}	6.93^{e}	3.68^{c}	5.63^{e}	6.82^{d}	3.74^{c}	5.87^{e}	6.88^{e}
10	4.29^{cd}	6.60^{e}	7.10^{e}	4.09^{c}	6.05^{e}	6.72^{d}	4.22^{c}	6.33^{e}	6.91^{e}
15	4.33^{cd}	7.65^{d}	8.24^{d}	4.27^{c}	7.11^{d}	7.71^{d}	4.30^{c}	7.38^{d}	7.98^{d}
20	4.39^{c}	9.60^{c}	10.43^{c}	4.09^{c}	9.12^{c}	10.10^{c}	4.24^{c}	9.36^{c}	10.26^{c}
25	6.15^{b}	10.77^{b}	12.42^{b}	6.22^{b}	10.22^{b}	12.43^{b}	6.18^{b}	10.50^{b}	12.43^{b}
30	9.25^{a}	13.30^{a}	14.17^{a}	9.18^{a}	12.50^{a}	13.86^{a}	9.22^{a}	12.90^{a}	14.01^{a}
SE±	0.1963	0.2184	0.3160	0.2983	0.2427	0.3850	0.2411	0.2240	0.3338
Interaction (AXB)	NS	NS	NS	NS	NS	NS	NS	NS	NS

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

NS = Not significant

WAT = Weeks after transplant

Table 6: Effects of irrigation intervals and cow dung rates (CD) on fresh weight of root/plant (g) of lettuce at 4, 6, and 8 weeks after transplant (WAT)

	Fresh weight of root per plant (g)								
Treatments	2014/2015			2015/2016			Combined mean		
	4	6	8	4	6	8	4	6	8
Irrigation interval (A)									
2 Days	4.19^{ab}	5.08^{a}	6.62^{a}	4.17^{a}	5.24^{ab}	6.73^{ab}	4.18^{a}	5.16^{ab}	6.68^{a}
3 Days	4.12^{ab}	5.11^{a}	6.71^{a}	4.16^{a}	5.18^{abc}	6.77^{ab}	4.14^{a}	5.14^{ab}	6.74^{a}
4 Days	3.63^{b}	4.83^{a}	6.51^{a}	3.72^{b}	4.79^{bc}	6.51^{b}	3.68^{a}	4.81^{ab}	6.51^{a}
5 Days	4.76^{a}	5.62^{a}	7.26^{a}	3.56^{b}	5.62^{a}	7.27^{a}	4.16^{a}	5.62^{a}	7.26^{a}

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6 Days	3.67^{b}	5.07^{a}	6.75^{a}	3.68^{b}	4.59^{c}	6.22^{b}	3.17^{b}	4.83^{b}	6.48^{b}
SE±	0.2059	0.2322	0.3083	0.1063	0.1723	0.2054	0.1505	0.1956	0.2532
CD (B)									
0.0t/ha	3.91^{cd}	3.85^{e}	5.49^{d}	3.13^{cd}	3.88^{f}	5.27^{e}	3.52^{d}	3.86^{e}	5.38^{e}
10 t/ha	3.01^{e}	4.51^{d}	6.10^{c}	2.97^{d}	4.33^{e}	6.11^{d}	2.99^{e}	4.42^{d}	6.11^{d}
15 t/ha	3.49^{de}	5.05^{c}	6.63^{c}	3.48^{c}	4.89^{d}	6.62^{c}	3.48^{d}	4.97^{c}	6.63^{c}
20 t/ha	4.17^{bc}	5.51^{b}	7.23^{b}	4.03^{b}	5.39^{c}	7.13^{b}	4.10^{c}	5.45^{b}	7.18^{b}
25 t/ha	4.61^{b}	5.71^{b}	7.36^{ab}	4.55^{a}	5.76^{b}	7.24^{b}	4.58^{b}	5.74^{b}	7.30^{b}
30 t/ha	5.27^{a}	6.22^{a}	7.80^{a}	4.98^{a}	6.26^{a}	7.81^{a}	5.12^{a}	6.24^{a}	7.80^{a}
SE±	0.1812	0.1493	0.1825	0.1568	0.1214	0.1591	0.1460	0.1255	0.1667
Interaction (AXB)	**	NS	NS	**	NS	*	**	NS	NS

Means in a column followed by the same letters are not significantly different from each according to DMRT

$*$ = Significant at 5% Level of probability $**$ = Significant at 1% Level of probability

NS = Not significant

WAT = Weeks after transplant

Dry Weight of root/plant (g)

The effects of irrigation intervals and cow dung rates on dry weight of root per plant of lettuce for the two seasons and combined mean are presented in Table 7. There was significant effect of irrigation interval on dry weight of root per plant in both seasons and the combined mean. Generally, 5 days irrigation interval was optimum for dry weight of root per plant in the two seasons and the combined mean at all sampling periods. Cow dung rates on the other hand had a significant effect on dry weight of root per plant of lettuce in both years and the combined mean. The application of cow dung up to 30t/ha favoured dry weight of root per plant of lettuce, while the control treatment with zero (0t/ha) cow dung produced the least of all.

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Shoot yield (kg/ha)

Effects of irrigation intervals and cow dung rates on fresh shoot yield per hectare at harvest of the lettuce in the year 2014/2015 and 2015/2016 dry seasons and the combined mean are presented in Table 8. Irrigation intervals statistically influenced shoot yield per hectare at harvest with an indication of 5 days irrigation intervals to be the optimum for the two seasons and the combined mean. Generally, the least shoot yield per hectare at harvest was obtained from 2 and 6 days irrigation intervals in both years and the combined mean. The cow dung application rate of 30t/ha gave significantly the highest fresh shoot yield per hectare and the least yield was from the lower cow dung rates for both the seasons and the combined means.

Table 7: Effects of irrigation intervals and cow dung (CD) rates on dry weight of root/plant (g) of lettuce at 4, 6, and 8 weeks after transplant (WAT)

	Dry weight of root per plant (g)								
Treatments	2014/2015			2015/2016			Combined mean		
	4	6	8	4	6	8	4	6	8
Irrigation interval (A)									
2 Days	0.98^{a}	1.71^{b}	1.90^{b}	1.00^{a}	1.63^{b}	1.67^{b}	0.99^{a}	1.67^{b}	1.79^{b}
3 Days	1.06^{a}	1.50^{b}	1.73^{b}	1.09^{a}	1.52^{a}	1.61^{b}	1.06^{a}	1.51^{b}	1.67^{b}
4 Days	1.09^{a}	1.62^{b}	1.89^{b}	1.09^{a}	1.66^{ab}	1.78^{b}	1.09^{a}	1.64^{b}	1.83^{b}
5 Days	1.90^{a}	2.10^{a}	2.36^{a}	1.10^{a}	1.91^{a}	2.05^{a}	1.10^{a}	2.01^{a}	2.20^{a}
6 Days	1.91^{a}	1.54^{b}	1.84^{b}	1.14^{a}	1.66^{ab}	1.77^{b}	1.07^{a}	1.60^{b}	1.80^{b}
SE±	0.0412	0.0722	0.0656	0.0648	0.0796	0.0731	0.0432	0.0614	0.0667
CD (B)									
0.0 t/ha	0.68^{c}	1.24^{e}	1.53^{e}	0.81^{cd}	1.26^{d}	1.43^{c}	0.75^{c}	1.25^{e}	1.48^{d}
10 t/ha	0.69^{c}	1.43^{de}	1.68^{de}	0.71^{d}	1.42^{d}	1.66^{c}	0.70^{c}	1.42d^{e}	1.67^{cd}
15 t/ha	0.82^{c}	1.60^{cd}	1.82^{cd}	0.90^{c}	1.52^{cd}	1.67^{c}	0.86^{c}	1.56^{cd}	1.74^{c}
20 t/ha	1.19^{b}	1.76^{bc}	2.04^{bc}	1.23^{b}	1.78^{bc}	1.64^{c}	1.21^{b}	1.77^{bc}	1.84^{bc}
25 t/ha	1.31^{b}	1.95^{b}	2.15^{b}	1.35^{ab}	1.88^{b}	1.97^{b}	1.33^{b}	1.91^{b}	2.06^{b}

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30 t/ha	1.52[a]	2.19[a]	2.43[a]	1.50[a]	2.18[a]	2.28[a]	1.51[a]	2.19[a]	2.36[a]
SE±	0.0750	0.0924	0.0778	0.0630	0.0985	0.1012	0.0545	0.0871	0.0842
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 according to DMRT

∗ = Significant at 5% Level of probability ∗∗ = Significant at 1% Level of probability

NS = Not significant

WAT = Weeks after transplant

WAT = Weeks after transplant

Table 8: Effects of irrigation intervals and cow dung (CD) rates on fresh shoot yield (kg/ha) of lettuce at harvest

	Shoot yield (kg/ha)		
Treatment	2014/2015	2015/2016	Combined mean
Irrigation interval (A)			
2 Days	6578.0[bc]	6600.0[b]	6589.0[b]
3 Days	6736.0[b]	6768.0[ab]	6752.0[ab]
4 Days	6728.0[bc]	6728.0[ab]	6728.0[ab]
5 Days	7235.6[a]	7222.0[a]	7228.8[a]
6 Days	6252.0[c]	6366.0[b]	6309.0[b]
SE±	138.81	164.14	150.12
CD (B)			
0.0 t/ha	5209[e]	5153[e]	5181[e]
10 t/ha	5396[de]	5376[de]	5386[de]
15 t/ha	5685[cd]	5710[d]	5697[d]
20 t/ha	6048[c]	6163[c]	6106[c]
25 t/ha	7829[b]	7999[b]	7914[b]

30 t/ha	10069[a]	10020[a]	10044[a]
SE±	127.01	126.95	121.93
Interaction (AXB)	**	**	**

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

∗ ∗ = Significant at 5% Level of probability

NS = Not significantly different from each other

Monetary Advantage of Irrigation Intervals and Cow Dung rates on Yield of Lettuce

Cost benefit of lettuce as influenced by irrigation intervals and cow dung rates in 2014/2014, 2015/2016 and the combined mean is presented in Table 9. The monetary advantage from 5 days irrigation interval was higher in both the years and the combined mean, proving to be the optimum, while 2 day irrigation interval produced the least amount in terms of monetary advantage. Application of 30t/ha of cow dung significantly produced higher monetary advantage in both the years and the combined mean. The lower rates of cow dung gave the least monetary advantage. There was significant interaction of irrigation intervals and cow dung rates on monetary advantage of lettuce from the seasons and the combined mean.

Table 9: Monetary Advantage of irrigation intervals and cow dung (CD) rates on Lettuce yield (kg/ha) and combined mean in 2014/15 and 2015/16 seasons

Cost Benefit (₦)			
Treatment	2014/2015	2015/2016	Combined mean
Irrigation interval (A)			
2 Days	73,167[d]	71,847[d]	72,507[d]
3 Days	172,247[c]	170,327[c]	171,287[c]
4 Days	201,847[bc]	201,847[b]	201,847[bc]
5 Days	255,487[a]	256,300[a]	255,893[a]
6 Days	212,127[b]	205,287[b]	208,707[b]

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SE±	9848.3	8328.8	9007.2
CD (B)			
0.0 t/ha	125,392^{d}	118,480^{d}	121,936^{d}
10 t/ha	130,960^{d}	132,160^{d}	131,560^{d}
15 t/ha	129,976^{d}	128,504^{d}	129,240^{d}
20 t/ha	162,568^{c}	165,928^{c}	164,248^{c}
25 t/ha	224,352^{b}	214,128^{b}	219,240^{b}
30 t/ha	324,600^{a}	327,528^{a}	326,064^{a}
SE±	7617.1	7620.4	7316.0
Interaction (AXB)	*	*	*

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

$*$ = Significant at 5% Level of probability

NS = Not significant

Conclusion

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

1. 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.

2. 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.

REFERENCE

Abu-Rayyan, A., Kharawish, B., Al-Ismail, K. (2004). Nitrate content in lettuce (*Lactuca Sativa L.*) heads in relation to plant spacing, nitrogen form and irrigation level. *J. Sci. Food Agric. 84: 931-936.*

Adetunji, I. A. (1990). Effect of mulches and irrigation on growth and yield of lettuce in Semi-Arid region. *Biotronics 19: 93-98.*

BOSADP (1993). Package of Cropping Recommendations for Borno State, Borno State Agricultural Development Programme, Maiduguri, Borno State.

Coelho A. F.S., Chulback, K., Gomes,E. P., Sousa, A. P., Gloria, M. B. A. (2005). Effects of irrigation level on yield and bioactive amine content of America lettuce. *J. Sci. Food Agric. 85: 1026-1032.*

Gomez, K.A., and Gomez, A.A (1984).Statistical Procedure for Agricultural Research, Second Edition. John Wiley, N.Y.

GSN (1994). Geological Survey of Nigeria. The survey of Nigeria's Climatic Data vol. 6, No. 3, cited in Daura, M.M. (2001), Physical Environment and Development; A Study of Borno region. In Ogonika, O.I., Daura M.M., and Balami, D.,(eds) Environment issues in Sub-saharan Africa. Seminar services vol. 1. Faculty of social and management sciences, University of Maiduguri. Pp. 35-47.

Norman,J.C. (1992). Tropical vegetable crops: Stockwell LTD. Illfracombe. United Kingdom. Pp. 121-129.

Ogbodo, E.N., Okorie , P.O., Utobo, E.B. (2010). Growth and yield of lettuce (Lactuva sativa L.) at Abakaliki: Agro-ecological Zone of South-Eastern Nigeria. *Journal of Applied Science, 6(10): 1488-1495.*

Rayar, A. J. (1984). Effect of organic manures on soil properties on soil properties. Research report, University of Maiduguri, Nigeria. Pp. 18-22.

Rhodes, D. (2004). Allergies of lettuce. *ACTA Horticulture, International Society for Horticultural Science, vol 555. Pp. 234-240.*

Tindall, H. D. (1992). Commercial Vegetable Growing. Tropical Handbooks Series, Oxford University Press. Oxford. Pp. 88-90.

Valenzuela, H.R., Kratky, B., Cho, J. (1996). *Research Extension Series 164, 630 US. Pp. 0271-0282.*

Vernon, G. (1999). Sustainable vegetable production from start-up to market. Ithca Inc. New York, U.S.A. *Fert. Int., 225: 43-49.*