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Influence of Irrigation Intervals and Sheep Dung Rate on Growth and Yield of Cabbage in Maiduguri, Nigeria

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Abstract: *Cabbage is one of most needed nutrious vegetable crops globally. The field experiments was conducted at the Teaching and Research Farm, of the Ramat Polytechnic, Maiduguri between February and May, 2019 to assess the level of sheep dung rate and irrigation intervals on growth and yield of the cabbage (Brassica oleraceae L.). The treatments used in this study were namely; sheep dung manure and irrigation interval each at three level, the sheep dung application rate used were (5t/ha, 10t/ha and 15 t/ha) and that of irrigation interval considered were (2days, 4days and 6day) each was laid out in a Randomized Complete Block Design (RCBD) was replicated two times to make total of 36 experimental units. The study revealed that sheep dung (SD) at 15 t/ha consistently recorded the highest value of all parameter studied. It was closely followed by 10 t/ha than other combination studied. Similarly, the use of 4 days irrigation interval showed superiority among the treatments in all the parameter investigated. The findings concluded that 15 t/ha of sheep dung rate combined with 4 day irrigation interval gave the best results. And also, considered as good agronomic record for semi-arid region with sandy loam in the study area.*

Keywords: *Cabbage, Irrigation Interval and Sheep dung.*

1.0 Introduction

Cabbage (Brassica oleraceae L.) belongs to the Brassicaceae family and is a cool season crop (Best, 2000). It is consumed raw or cooked with other vegetables and mostly grown as a commercial crop. It contains 93 ml water, 1.5 g protein, 0.2 g fat, 4 g carbohydrate, 40 mg calcium and 0.5 g iron/100 g sample (Albrizio *et al*., 2010). Cabbage is one of the priority vegetable crops in the diet of the most African people (Cooper, 2000). Nigeria is the country with high rain fall. But, during winter season rain fall of the area is erratic and cannot fulfill crop requirements. In summer season the rain fall is high and cabbage is very susceptible for different diseases as well as the high amount of water causes splitting the cabbage head. The availability of cabbage in the market is low as compared to winter season and is mostly needed as a fastening food. Farmers in these areas have low knowledge of timely and optimum application of irrigation. Cabbage water requirements are approximately 440mm depending on climate and length of growing season, the crop transpiration increases during the crop growing period with a peak toward the end of the season. Depending on climate, crop development and soil type, the frequency of irrigation varies between 3 and 12 days. If water supply is limited, early irrigations should not be practiced. Water savings should preferably be made in the beginning of the crop growing period (Xu *et al*., 2014). Cabbage is

more susceptible to water stress and nitrogen deficiency. Improper irrigation management practices cause not only wastage of scarce water resources but also decreases crop yield, quality, water use efficiency and economic return as well as leads to water logging and salinity which can be partly corrected by expensive drainage system (Himanshu *et al*., 2012). For cabbage production in dry area or in the summer season farmers use irrigation. Most of them are producing different horticultural crops. From this cabbage is one of most needed crops around many area. But the production of these crops is less because from sowing up to harvesting it needs better crop management as well as protection from different disease and insects attack. For these reason the price of these crops is very high in winter as well as in summer (Jimma, 2015).

Globally, Irrigation scheduling is one of the factors that influence the agronomic and economic viability of small farms. Fertility of most soils in semi-arid region has already declined due to continuous cropping, abandoning of fallowing, reduced use of manure and crop rotation (Haileslassie et al., 2005; 2006 and 2007). The use of animal manure and crop residues for fuel and erosion coupled with low inherent fertility are among the main causes for decreasing soil fertility (Tilahune *et al*., 2007). Irrigation scheduling is a critical management input to ensure optimum soil moisture status for proper plant growth and development as well as for optimum yield, water use efficiency and economic benefits. Therefore, it is essential to develop irrigation scheduling strategies under local climatic conditions to utilize scarce water resources efficiently and effectively (De Fraiture *et al*., 2010).

Poultry manure, an efficient organic fertilizer is readily available in the Seychelles, in sufficient amounts and it is an important source of plant nutrients (Reddy and Reddi, 1995). In addition to releasing nutrients, also improves the physical properties of soil. It has been reported that 30 % of nitrogen from poultry litter is in urea or ammonium form and is hence readily available (Sunassee, 2001). Its average primary nutrient content is 3.03 % N, 2.63 % $P_2 O_5$ and 1.4 % K_2 O (Reddy and Reddi, 1995). In addition, the amount of organic fertilizer needed for optimum production of most vegetable is also context specific and the current recommendation is generalized. Considering the above facts, the present investigation was undertaken to determine the most effective irrigation interval and dosage of sheep manure on growth and yield of cabbage.

2.0 Materials and Methods

2.1 Experimental Site Description

The experiment was conducted at the Ramat Polytechnic Teaching and Research farm Maiduguri during the dry season between Februarys to April, 2018. Maiduguri i.e. on latitude 1 1.4°N and longitude 13.05°E it has the altitude of 354m above sea level Bashir., 2015).The average annual rainfall is around 640mm and the temperature is high ranging between 20-40^{o}C (Dalorima, 2002). The area is highly susceptible to drought with relative humidity of 13% and 65% in dry and rainy season respectively (Bashir, 2014). Also the area is vulnerable to desertification (Dibal, 2002).

Table 1: Soil Characteristics of the Experimental Site (0-30 cm)

Soil type (USDA soil classification)	Sand loamy
Clay (%)	8.0

Silt (%)	11.8
Sand (%)	80.2
P ^{H}	6.8
Field capacity (vol. %)	16.2
Wilting point (vol. %)	3.2
Available water content (vol. %)	13.0
Bulk Density (g/cm^3	1.70
Organic matter (%)	3.99

Source: Agricultural Research Farm Rampoly

2.2 Treatment and Experimental Design

The experimental factors considered in this studies were irrigation interval and organic fertilizer (Sheep Dung) each at three level. The irrigation interval (IR_{in}) selected were namely I_2 day, I_4 day and I_6 days; while the decomposed sheep dump (SD) were namely: 10 t/ha, 15 t/ha, and 20 t/ha as presented in Table 2. The treatments were laid out in a randomized complete block design (RCBD) with three replications as shown in Figure 2.

Table 2. Treatment combination of irrigation schedules with fertilizer

Application day	Sheep manure (t/ha)	Treatment combination
2 days	5	2 days x 5 kg
	10	2 days x 10 kg
	15	2 days x 15 kg
4 days	5	4 days x 5 kg
	10	4 days x 10kg
	15	4 days x 15 kg
6 days	5	9 days x 5 kg
	10	9 days x 10 kg
	15	9 days x 15 kg
		Total 3+3+3=9 x2 = 36

Figure 2: Showing replication of the treatment

2.3 Agronomic Practice

The experimental plot area was 24 m^2 with bed size of 1.5 m×2 m .The variety of cabbage used was 'Spring Light'. It is popularly grown by farmers, both for home use and source of income. Seedlings of the selected cabbage variety were raised in the seed bed one month

before the actual transplantation (February 07, 2019), healthier and uniform seedlings were transplanted into a hole of 6cm depth at a spacing of 45 cm x 45 cm between and within rows in each treatment plot. Thus, the unit plot accommodated a total of 9 plants. The seedlings were watered immediately after transplantation at field capacity. The organic fertilizer were applied at the different rates of 65.5 g, 125.5g and 187.5g (equivalent of 5 t/ha, 10 t/ha and 15 t/ha tonnage as stated in section 3.2) were applied in each hole a day before transplanting.

2.4 Data Collection

To evaluate influence of irrigation interval and sheep manure rate on cabbage growth and yield three samples were taken per plot. Based on three sampled head height, head diameter, Number of leaf per plant and yield from each experimental unit were captured and their mean values were used for the computation.

2.4.1 Plant height (PH)

Cabbage plant height was measured at 4, 6 and 12 week after transplanting from selected plant per plot and their mean were recorded. The measurement was done with ruler from the tip head to down the collar at maturity and expressed in centimeter.

2.4.2 Number of leaves per plant (NLPP)

Number of leaves per plant were counted at 4, 6 and 12 week after transplanting from the selected plant per plot and their mean were recorded.

2.4.3 Head diameter (HD)

At harvest, that is maturity stage, the head diameter and head height of the selected plant in each plot was measured at widest part using tape and ruler and their mean were recorded.

2.4.4 Yield Parameter

The selected sample plants were taken from each plot and the whole plant parts was measured using beam balance (model WA310rev-B. Aeadam equipment).

2.5 Statistical Analysis

The data were statistically analyzed using the Analysis of Variance (ANOVA) while the Least Significant Difference (LSD) was used to separate treatment means following the method of Obi, (1990).

3.0 Results and Discussion

3.1 Irrigation Interval and Sheep Dung Rate on the Cabbage Height

The result of irrigation interval and sheep dung dose on the cabbage height at 4, 8 and 12 weeks after transplanting (was) were presented in Table 3.

Table 3. Irrigation Scheduling and Sheep Dung Rate on the Cabbage height in (cm)

Treatment	Week After Transplanting		
Sheep Dung (g/m^2)	4	8	12
SD1 (65.5)	6.533c	15.533ab	25.567b
SD2 (125)	11.233a	17.567a	32.633a
SD3 (187.5)	8.933b	15.267b	29.033c
Significance	*	*	*
SE±	0.6472	0.7843	1.7149
Irrigation Interval			
IT (2days)	5.9667b	15.2b	25.7a

IF (4days)	9.7333a	19.067a	31.967a
IS (6days)	7.1ab	16.833c	31.367b
Significance	NS	**	NS
SE±	1.0477	0.895	1.3596
Interaction			
SD × Iin	*	*	*

Means within a column followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT).

The irrigation interval and sheep dung used as treatment were significantly ($p<0.05$) influenced the Plant height of cabbage as presented in Table 3. The highest Plant height at all weeks after transplanting was observed in S_{D2} with corresponding PH values (11.233cm, 17.567 and 32.633) respectively. It was closely followed by S_D3 at same weeks after transplanting and the least of (6.533, 15.533 and 25.567) at 4, 8 and 12 WAT remarkable recorded affect by S_{D1}. This was attributed to the fact that higher manure levels favored the growth of plants height with larger leaf area and it was more usefully utilized in head formation. Similar observations on cabbage were made by Ghantis *et al*. (1982)

Likewise, irrigation interval variation significantly ($P<0.05$) affected cabbage plant height. The highest plant heights of (9.73 cm, 19.06cm and 31.96cm) at 4, 8 and 12 WAT was affected by 4day irrigation interval. It was closely followed by 2day irrigation interval at 4 and 8 WAT with corresponding plant height values of 5.966cm and 15.20 cm respectively. While the least of 16.833 at 8WAT was recorded with 6days irrigation interval used as treatment. This result was supported by findings of Kadyampaken, (2013). Similarly, the interactions between the sheep dung used as organic manure and different irrigation interval were significant

3.2 Influence of Irrigation Scheduling and Sheep Dung Rate on the Number of Leaves per Cabbage

The result of Irrigation Scheduling and Sheep Dung Rate on the Number of Leaves per Cabbage at 4, 8 and 12 Weeks after transplanting were presented in Table 4.

Table 4. Influence of Irrigation interval and Sheep Dung Rate on the Cabbage number of leaves

Treatment	Week After Transplanting		
Sheep Dung g/m^2	4	8	12
S_{D1} (65.5)	7.33^b	15.00^b	19.67^a
S_{D2} (125)	11.00^a	15.00^b	19.00^a
S_{D3} (187.5)	8.33^{ab}	17.00^a	20.33^a
Significance	*	*	NS
SE±	1.28	1.28	1.21
Irrigation Interval			
IT (2days)	6.33^b	13.33^b	17.67^b
IF (4days)	8.00a	17.33a	24.00^a
IS (6days)	6.67^b	14.00^b	18.67^b
Significance	NS	*	*
SE±	1.05	1.09	1.04
Interaction			
SD × I_{in}	NS	NS	NS

Means within a column followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT).

As shown in Table 4. The treatment combination were significantly (P<0.05) influenced the number of leaves per plant of cabbage. Highest number of leave per plant of (11, 15 and 19) was affected by sheep dung at 125 g/m^2, closely followed by 10t/ha at 8WAT and 12WAT with corresponding number leaf number per plant of 15 and 19 respectively. While the least was affected by both 187.5 g/m^2 and 65.5 g/m^2 at 4 WAT. Similarly the variation of irrigation interval has significantly influenced the number leaf per plant of the cabbage. Highest number of leaf per plant of (8, 17 and 24) at (4, 8 and 12) week after transplanting was affected by 4days irrigation interval, closely followed by both 2day and 6day irrigation interval. Similar results were observed by (Mustafa and Zohair, 2013). Likewise, the interaction between sheep manure and irrigation interval were not significant.

3.3 Influence of Irrigation Scheduling and Sheep Dung Rate on Yield and Yield Parameter of Cabbage

The result obtained on the Influence of irrigation scheduling and sheep dung application rate on head height, head width and the yield of the cabbage were presented in Table 5

Table 5. Influence of Irrigation Scheduling and Sheep Dung Rate on Yield and Yield Parameter of Cabbage

Treatment	HH (cm)	HW (cm)	Yield in kg	Yield in t/h
Sheep Dung g/m^2				
S_{D1} (65.5)	14.04^{b}	9.28^{b}	4.17^{c}	41.73^{c}
S_{D2} (125)	16.85^{a}	15.68^{a}	6.60^{a}	65.97^{a}
S_{D3} (187.5)	15.05^{ab}	9.78^{c}	4.02^{b}	40.23^{b}
Significance	*	*	*	*
SE±	0.76	0.89	0.61	6.14
Irrigation Interval				
IT (2days)	12.93^{a}	12.00^{b}	3.76^{b}	37.57^{c}
IF (4days)	14.93^{a}	13.59^{ab}	6.76^{a}	67.57^{a}
IS (6days)	14.34^{a}	14.10^{a}	4.06^{b}	40.57^{b}
Significance	NS	*	*	*
SE±	1.49	0.71	0.44	4.42
Interaction				
SD × I_{in}	*	*	*	*

Means within a column followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT).

As presented in the Table 5, both sheep dung application rate and irrigation interval used as treatment were significantly (P<0.05) increased yield parameter and yield of cabbage. Application of sheep manure up to 125g/m^2 steadily increased parameters such as head height, height width and yield in t/ha of the cabbage with correspondent value 16.58 cm 15.68 cm and 65.97 kg/ha respectively, it was closely followed by 65.5g/m^2 with 41.73 kg/ha of fresh cabbage yield. And also, the least yield parameter was remarkable recorded with 187.5g/m^2 sheep manure, this could be attributed to the antecedent soil fertility rate of the study site. Similarly the irrigation interval variation significantly influenced the yield and it attribute, but didn't affected the head height of cabbage. However, the head width and the yield was significantly affect by the 4days and 6days irrigation interval, resulted to 67.57 kg/ha and 40.557 kg/ha respectively. The interaction between sheep manure rate and irrigation interval were significant.

4.0 Conclusion and Recommendations

4. 1 Conclusion

The study revealed that irrigation interval at 4 days and sheep dung rate at 125 g/m^2 (equivalent to 10t/hac) had a significant influence the plant height, number of leaves per plant, head height and head width parameter of the cabbage at all Week after transplanting, as well at the maturity. The combined effect of sheep manure rate at 125 g/m^2 and 4 days irrigation interval gave the best result. It is therefore suggested as the best practice in the study area.

4.2 Recommendations

The following recommendations were made;

1. Farmer should use 4 days' irrigation scheduling and 10 t/ha of sheep manure rate for their increment of cabbage yield.
2. Further research need to be carried out at different seasons of the year
3. Further research need to be carried out at different soil type, cabbage varieties and farm practice.

References

Aalbersberg, I.J.W. and Stolk, J.H. (1993). 38e Descriptive List of Varieties of Vegetables for Field Cultivation 1994 (In Dutch). Cpro-Dlo, Wageningen, the Netherlands, 259 Pp. (Cited y Everaarts& De Moel, 1998).

Abdul Haris1, Kumar, S. and Singh, A.K. (2014). Water Requirement and Irrigation Scheduling through Drip Systems in Cabbage (Brassica oleracea Var. Capitata). HortFlora Research Spectrum, 3(2): 166-168 (June 2014)

Agricultural Sample Survey, (2012). The Federal Democratic Republic of Ethiopia Central Statistical Agency. Report on Area and Production of Major Crops (Private Peasant Holdings, Meher Season).

Albrizio, R., Todorovic, M. Matic, T. and Stellacci, A. (2010). Comparing the interactive effects of water and nitrogen on durum wheat and barley grown in a Mediterranean environment. *Field Crops Research*, **115**:179–190

Allen, R., Pereira, L., Raes, D. and Smith, M. (1998). Crop evapotranspiration: guidelines for computing crop water requirements. FAO Irrigation and Drainage. Rome, Italy: FAO. 56.

Birhanu, M., Awoke, Y. Tahgas, A. and Raja, N. (2011). Efficacy of Melia azedarach and Mentha piperita plant extracts against cabbage aphid, Brevicornye brassicae (Homoptera: Aphididae). World Appl. Sci. J., 12(11): 2150-2154.

Bray, R.H and Kurtz, L.T. (1945). Determination of Total Organic and Available Phosphorus in soils. Soil Sci., 1945. 59: 39-45.

Bremmer, J.M.(1965). Total Nitrogen.In Methods of Soil Analysis, Part 2. American Soc. Ag. Inc. Pub. Agronomy Series, No.9, Ed., C.A. Black. Madison, Wisconsin, pp: 1149-1178.

Bremner, J.M. and Mulvaney, C.S. (1982). "Total nitrogen", In: A.L. Page, R.H. Miller and D.R. Keeny, (Eds.), Methods of Soil Analysis, American Society of Agronomy and Soil Science Society of America, Madison, 1119-1123.

Broner, I. and Schneekloth, J. (2003). Seasonal Water Needs and Opportunities for Limited Irrigation for Colorado Crops, Newsletter of the Extension Irrigation Services, Dept. of Civil Engineering, Colorado State University. No. 4.718 http:/www.google search/water requirement.

Bafna, A. M., Dafterdar, S. Y., Khade, K. K., Patel, P.V. and Dhotre, R.S., (1993). Utilization nitrogen and water by tomato under drip irrigation systems. J. Water Management, 1 (1): 1-5.

Best, K. (2000). Adaptation of Cabbage Varieties. ARP Training Reports. AVRDC-AFRICA Regional Programme, Arusha, Tanzania,p.10.

Xu, C. Leskovar, D.I. (2014). Growth, physiology and yield responses of cabbage to deficit irrigation Texas A&M Agri Life Research Center, Vegetable and Fruit Improvement Center, Department of Horticultural Sciences, Texas A&M University, USA 41(3): 138–146. Drew, D.H. 1966. Irrigation studies on summer cabbage. J. Hort. Sci.41:103-114.

Cantliffe, D. J. and Karchi. Z. (1992). Performance of crisp head lettuce cultivars on polyethylene-mulched, drip-irrigated sandy soils in Florida. Proc. Fla. State. Hort. Soc. 105, 340-342. (Cited by SOUNDY et al., 2001a).

Cesalis, T. R. (2002). Yield Evaluation of Lettuce Varieties. *Agricultural Technology Journal*, 5: 20-24.

Cooper, S. S. (2000). Adaptation Trial on Heading Cabbage Cultivars in Rundu, Namibia. *Namibia Agricultural Journal*, 2 (1): 20 – 24.

Grubben, G.J.H. (1997). Tropical Vegetable and Their Genetic Resources. Royal Tropical Institute, Amsterdam, Netherland, p. 102.

Davie, M. K. 2013. Comparative Response of Cabbage to Irrigation in Southern Malawi. Journal of Agricultural Science; Vol. 5, No. 8.

De Fraiture, C., and Wichelns, D. (2010). Satisfying future water demands for agriculture. Agricicultural Water Management, 97(4), 502-511. http://dx.doi.org/10.1016/j.agwat.2009.08.008

De Fraiture, C., Molden, D., & Wichelns, D., 2010. Investing in water for food, ecosystems, and livelihoods: An overview of the comprehensive assessment of water management in agriculture. *Agricicultural Water Management*, *97*(4), 495-501.

Dinkova-Kostova, A.T., Kostov, R.V., (2012). "Glucosinolates and isothiocyanates in health and disease". *Trends Mol Med* **18** (6): 337–47. doi: 10.1016/j.molmed.2012.04.003. PMID 22578879.

Doo Doorenbos, J., and Kassam, A. H. (1979). *Yield Response to Water*. FAO Irrigation and Drainage paper no. 33.

Best, K. (2000). Red Onion Cultivars Trial. Horticultural Nova Scotia, Kentrille Agriculture Centre, Nova Scotia (Canada): 10-13.

Boukary, H., Haougui, A. Barage, M. Adam, T. Roumba, A. et, Saadou, M. (2012). Evaluation agro-morphologique des Variétés et/ou écotypes locaux d'oignon du Niger. *Int. J. Biol. Chem. Sci.* 6 (6): 3098-3106.

Brice, J., Currah, L. Malins, A. and Brancoft, R. (1997). Onion storage in the tropics: A practical guide to method of storage and their selection Chatham U.K. National Resource Institute. pp 4-6.

Eugeniusz, K. and Piotr, C. (2015). Control of Head Size and Nutritional Value of Cabbage by Plant Population and Nitrogen Fertilization. *Acta Sci. Pol. Hortorum Cultus 14(2), 2015, 75-85.*

Everaarts, A.P. and De Moel, C.P. (1998). The Effect of Nitrogen and the Method of Application on Yield and Quality of White Cabbage. *European J. Agron.*9, 203-211

Everaarts, A.P. (1993a). General and Quantitative Aspects of Nitrogen Fertilizer Use in the Cultivation of *Brassica* Vegetables. *ActaHortic.*339, 149-160.

FAO (Food and Agriculture Organization), (2002). Crops and Drops. Land and Water Development Division. Rome, Italy.

FAO, (2012). Crop water information: cabbage journal of natural resource and environment department, 1:991-2

FAO, (2015). Ethiopia Irrigation market brief. Financial Analysis of Small Scale Irrigation Based Vegetable Production in Wondo Genet District of Sidama Zone, Southern Ethiopia Woldemichael Somano1 and Tewodros Tefera2* 2015. Ethiop. J. Appl. Sci. Technol. Vol.6 (2): 35-52.

Fisseha, I. (2002). Metals in Leafy vegetables grown in Addis Ababa and toxicological Implication, Ethiop. J. Health Dev. Vol. 16(3), 295-302.

Fistum, H., Gayathri J. Seleshi, B.A., Mekonen L., Aster D.Y., (2012). Agricultural water management and poverty in Ethiopia. J, Agricultural Economics. 43(1):1-13

Food and Agriculture Organization (FAO), (2005). Irrigation water requirements, In: Irrigation Potential in Africa: A Basin Approach, Chapter 5, FAO Corporate Document Repository, FAO, and Rome. http://www.fao.org/docrep/W 4347E /w4347e00.htm

Frezer, A. (2007). Effect of Planting Density and Nitrogen Application on Yield and Yield Components of Potato at Enderta, Southern Tigray, Ethiopia. MSc. Thesis presented to Haromaya University. pp 18-27.

Rajkomar, I. (2002). Comparative Performance of Three Cabbage Varieties to Different Rates of Poultry Manure in Madagascar. *Netherlands Journal of Agricultural Science*, 41: 98-101.