JOURNAL OF METEOROLOGY AND CLIMATE SCIENCE
J. Met & Clim. Sci. 18(1): 1-6 (March, 2020)

N.Met.S
Nigerian Meteorological Society

Periodic Evaluation of Atmospheric Dew and Dust in Iso-olu Area of Abeokuta, Nigeria

Eruola, A.O[1]*, Makinde, A.A[1], Ladejobi, Y.F[1]., Ayoola, K.O.[1] and Nwamini, L.O.[1]
[1]*Department of Water Resources Management and Agrometeorology, Federal University of Agriculture, Abeokuta, Nigeria*
**Corresponding Author E-mail: layosky@yahoo.com*

Abstract: *Air pollution in the form of atmospheric aerosols in the troposphere is known to have adverse influence on hydrological cycle and subsequently affecting crop production. In assessing atmospheric particulates and moisture in Iso-olu area of Abeokuta, the weights of dew and dust particles captured were observed at different elevations and climatic periods. The experiment was carried out for seven days during each climatic period between May and December. The experiment involved five climatic periods, two sieve mesh sizes and two elevations. The weight of dew and dust collected during the different rainfall seasons in relation to elevation and mesh sizes were analyzed with respect to treatments using ANOVA. The result showed significant variation in dew at different rainfall periods and at varying levels of collection under different sieve sizes. The highest dew was collected at the onset of rains at the upper collection level under no sieve cover; the lowest dew was collected in the dry period in November at the lower collection level irrespective of sieve size. Similarly, there was significant variation in dust at different levels of collection under different sieve sizes. More dust was collected at the upper level and at 500 mm sieve size. High dust values were observed to be associated with dry periods. The majority of air pollution dust problems are caused by nontoxic limestone dust associated with quarry activities in the study area,*

Keywords: *Rainfall, moisture, aerosols, sieve, mesh, elevation*

INTRODUCTION

The occurrence of dew in the atmosphere is important for agricultural and hydrological processes when rainfall is limited [1,2]. Dew resulting from low surface temperature and sufficient amount of vapour in the air provides limited atmospheric moisture for the surface of objects near the ground, in particular, the immediate vicinity of plant surfaces. The plant leaves absorbs dew for the restoration of plant water status thereby regulating growing environment of forest plants and also reducing the rise in both the leaf temperature and rate of evapo-transpiration.

Apart from its importance in the survival, growth and development of the plants, most especially, in the arid and semiarid environment, dew also improves hydrological processes, such as soil water balance, by reducing transpiration losses of water and minimises crop water requirements as reported by researchers [3] – [4]. Aside its beneficial contribution to the environment, dew also contributes harmful effects. Among the damaging effects are induction of plant disease through the release of spores from pathogen of fungus and bacteria [5]; and also reduction of output and quality of crops. These harmful effects are attributed to its moisture condition and acidification level. The acidification level of dew is as result of its contact with atmospheric aerosols which are complex chemical mixture of solid and liquid particles suspended in air [6]. Among the atmospheric aerosols contributing to acidification of dew is the atmospheric dust, SO_2, NO_2 and O_3.The research on how dust pollution effects atmospheric moisture in the ecosystem has never received the same level of attention as that given to phytotoxic pollutants such as SO_2, NO_2 and O_3. Where available, dew research is dominated by phyto-pathologists who are concerned with the calculation of leaf wetness duration that is related to plant disease occurrence [7]. However, vigorous scientific effort is currently underway to assess the effect of atmospheric aerosols on surface temperatures and climate [8]. Results from research that has been undertaken, together with repeated observations of dust deposits on vegetation, suggest that the effects of dust may be important and are worthy of greater research attention. Among such research are those of Singh [9] that showed that there has been increasing emission of atmospheric fine particles resulting from natural and overwhelming anthropogenic sources in pollution. Bearing in mind that fine particles typically resides and transported over thousands of kilometers under the appropriate meteorological conditions in the atmosphere for days to weeks before being removed. It is therefore imperative to assess the impact of dew in relation to dust particle in our environment. This paper assesses the effect of atmospheric particulates on atmospheric moisture in Iso-olu area of Abeokuta, Nigeria.

RESEARCH METHODOLOGY

Description of the Study Area

Abeokuta lies between latitude 7˚10´ N and 7˚24´ N between longitutde 3˚20´ E and 3˚42´ E. It is located at about 100km north of Lagos and 80km south-west of Ibadan covering an area of 1382.9 km². It is within the tropical humid climatic zone of Nigeria which generally is characterized by high rainfall and high relative humidity. This is attributable to the prevalence of moisture laden tropical Maritime air mass over the state for about nine months in a year. The mean relative humidity varies from 66.2% in January to 88.4% in July [10]. The rainfall shows a double peak distribution reaching the peaks in the months of June and September. The dry season sets in by November and persists till the end of January. It is usually accompanied by harmattan cold brought by the prevailing north-west winds.

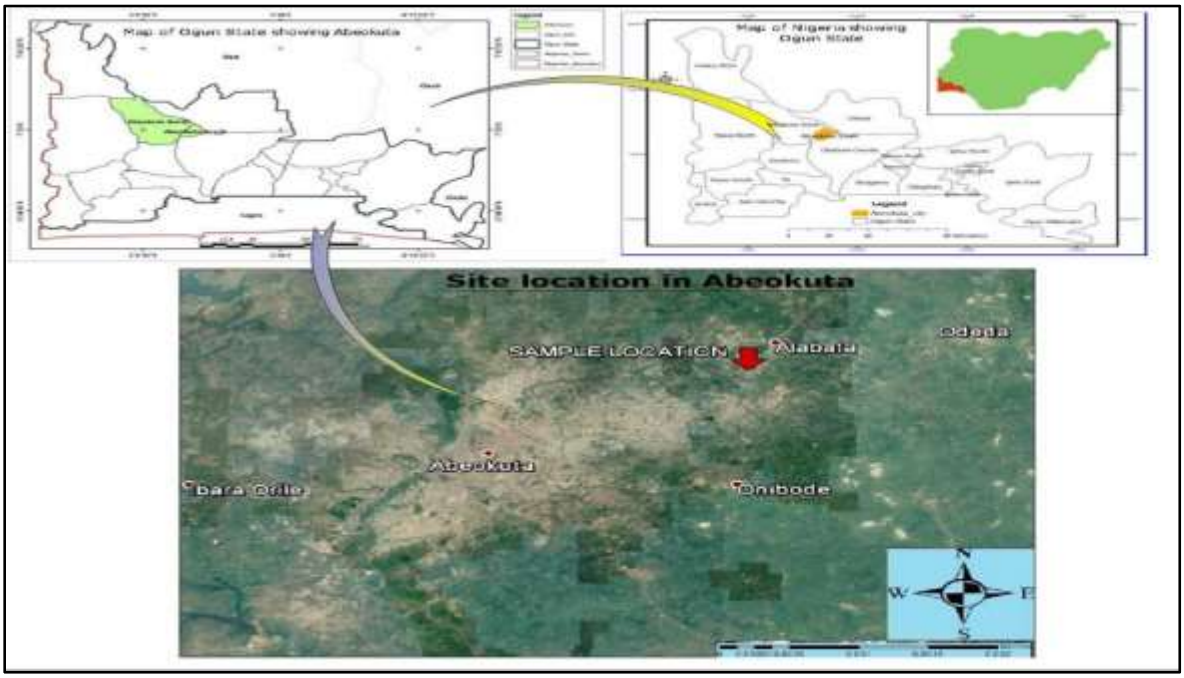

Figure 1: Map of Iso-olu in Odeda Local Government Area, Ogun State.

The average monthly rainfall for the state ranges between 7.1 mm in the month of January and 208.27mm in the month of June. The mean annual temperature is 26°C; although with some variations over time. The mean diurnal minimum temperature varies from 21.8°C in December to 24.34°C in April while the mean diurnal maximum temperature varies from 33.92°C to 37.1°C at the onset of the wet season (March and April) [10].

Description of Method

The present study was used to characterize, understand and interpret observed anomalies in the atmosphere. Dew and particulate samples were collected from two elevations (2 m and 9 m). The particulate (dust) was captured using sieves of 200 mm, 500 mm and no sieve mesh cover, while the dew was collected using blotting paper (bibulous paper) placed under the sieves mesh. The initial weight of paper and sieves were taken using weighing balance at 4 pm and final weight taken at 7 am of the following day. The papers were placed under the no mesh cover, 200 mm and 500 mm mesh following the treatment adopted. The experiment was conducted daily for 7 days each during Onset of rainfall in May, Peak in June, August-break and Cessation of rain in November and during dry season in

December (Harmattan) of 2018. The experimental design involves two elevations 2 m (down) and 9 m (up) from the ground representing standard wind speed measurement elevation, three mesh for dew and dust collection (no mesh, 200 mm and 500 mm) and five moisture periods (Onset, Peak, August-break, Cessation and dry season) in randomized complete block design with three replicates. Data collected was analysis based on the design using analysis of variance (ANOVA) and the differences between treatment means compared by using DMRT at 5% probability.

RESULTS AND DISCUSSION

The weight of atmospheric dew and dust available in the study area are summarized in Table 1 and 2 respectively. The periodical characterization of dew in the study indicated significant variability between the different levels of collection under different sieve sizes. The highest dew of 2.05 g was collected in May which marked the onset of rains at the upper collection level when it was uncovered with sieve. The lowest amount of dew of 0.01 g was collected mostly in November at the lower collection level irrespective of sieve size. The low dew experienced in November is as a result of the period of the year coinciding with dry season when atmospheric dusts are dominant thereby attracting water molecules thus reducing the amount of moisture in the atmosphere.

Generally, it was observed that there are significant periodical variations in dew, irrespective of mesh size. Furthermore, more dew was collected at higher level, irrespective of mesh size, indicating the dominance of atmospheric moisture at upper atmosphere than at the ground level. This may be due to saturated air experienced at the upper level resulting from cooler temperature encountered at such high level and the radiation effect at lower level. Similar to the observation in the atmospheric dew characterization, there are significant variation in the periodic dust level with sieve sizes and elevation. More dust was collected at the upper level and at 500 mm sieve size. High dust values were observed to be associated with dry periods. The indication of high dust in dry season is probably due to the high electrostatic attraction in the atmosphere in the area [11]. The majority of air pollution dust problems are caused by nontoxic dusts such as limestone, cement dust, and various other minerals. The excessive emissions of nontoxic dusts into the atmosphere are the nuisances of dust fall and visibility reduction resulting from quarry activities close to location. High concentrations of dust may occasionally damage vegetation by inhibiting the normal respiration and photosynthesis mechanisms within the leaf. Quarry dust may cause chlorosis and death of leaf tissue by the combination of a thick crust and alkaline toxicity produced with high dew formation or in wet weather. The dust coating also may affect the normal action of pesticides and other agricultural chemicals applied as sprays to foliage [12]. In addition, accumulation of alkaline dusts in the soil can increase soil pH to levels adverse to crop growth.

CONCLUSIONS

There are significant variation in the atmospheric dew and dust concentration in the study area during experimental period. The highest concentrations of dew were observed during the onset of rain, while dust concentration in the atmosphere was predominant during the dry season. The concentration of both dew and duct were predominantly higher at upper atmosphere at 9 m elevation. The high atmospheric particles (dust) could be associated with the quarry activities in the area which may have adverse effect on agricultural production and environmental health, in particular, human health. To this end, it is recommended that all environmental advocates should support societal control of air pollution and rally against attempts to weaken science-based regulatory air pollution standards. Furthermore, the potentials of dew for irrigation of seeds at germination stage at dry spells between rains during the onset of raining season should be fully explored, due to supply low water.

Table 1: Dew collection (in g) at different elevation, under different sieve mesh sizes at different rainfall periods.

		Dew													
Treatment		**Day 1**		**Day 2**		**Day 3**		**Day 4**		**Day 5**		**Day 6**		**Day 7**	
Season	**Mesh**	**Up**	**down**	**Up**	**Down**	**up**	**down**	**Up**	**down**	**Up**	**down**	**up**	**down**	**up**	**down**
May	0	1.64^{a}	0.22^{def}	0.16^{c}	0.05^{defg}	2.05^{a}	1.55^{b}	0.82^{a}	0.1^{cd}	0.13^{c}	0.05^{ghijkl}	0.14^{cd}	0.04^{d}	0.11^{cdefg}	0.06^{ghij}
	200	1.73^{a}	0.16^{def}	0.06^{defg}	0.02^{g}	1.8^{ab}	1.54^{b}	0.14^{cd}	0.07^{cd}	0.08^{defgh}	0.03^{jkl}	0.76^{b}	0.02^{d}	0.05^{ghij}	0.02^{ij}
	500	1.61^{a}	0.30^{de}	0.08^{def}	0.03^{fg}	1.99^{a}	1.21^{c}	0.5^{b}	0.05^{d}	0.11^{cde}	0.04^{hijkl}	0.66^{b}	0.04^{d}	0.06^{fghi}	0.02^{ij}
July	0	0.09^{ef}	0.04^{ef}	0.2^{c}	0.03^{efg}	0.12^{d}	0.07^{d}	0.09^{cd}	0.04^{d}	0.12^{cd}	0.04^{hijkl}	0.08^{d}	0.04^{d}	0.15^{c}	0.1^{cdefgh}
	200	0.04^{ef}	0.02^{f}	0.09^{d}	0.05^{defg}	0.08^{d}	0.04^{d}	0.06^{cd}	0.03^{d}	0.09^{defg}	0.03^{ijkl}	0.07^{d}	0.03^{d}	0.23^{b}	0.08^{defghi}
	500	0.06^{ef}	0.02^{f}	0.09^{d}	0.03^{efg}	0.1^{d}	0.05^{d}	0.1^{cd}	0.05^{d}	0.09^{cdef}	0.05^{ghijkl}	0.06^{d}	0.03^{d}	0.15^{cd}	0.08^{defghi}
August	0	0.40^{c}	0.14^{def}	0.05^{defg}	0.05^{defg}	0.06^{d}	0.03^{d}	0.13^{cd}	0.05^{d}	0.11^{cd}	0.06^{fghijk}	0.09^{d}	0.05^{d}	0.08^{defghi}	0.14^{cde}
	200	0.80^{c}	0.09^{ef}	0.06^{defg}	0.03^{efg}	0.04^{d}	0.03^{d}	0.08^{cd}	0.03^{d}	0.05^{ghijkl}	0.02^{kl}	0.06^{d}	0.04^{d}	0.06^{fghi}	0.03^{ij}
	500	1.13^{b}	0.18^{def}	0.08^{de}	0.03^{efg}	0.05^{d}	0.04^{d}	0.1^{cd}	0.04^{d}	0.07^{efghij}	0.02^{kl}	0.11^{d}	0.05^{d}	0.07^{efghij}	0.05^{ghij}
November	0	0.15^{def}	0.01^{f}	0.96^{a}	0.05^{defg}	0.97^{c}	0.03^{d}	0.3^{c}	0.02^{d}	0.72^{a}	0.05^{ghijkl}	1.05^{a}	0.03^{d}	0.4^{a}	0.4^{a}
	200	0.11^{ef}	0.02^{f}	0.82^{b}	0.06^{defg}	0.08^{d}	0.03^{d}	0.02^{d}	0.01^{d}	0.09^{cdef}	0.02^{l}	0.08^{d}	0.03^{d}	0.27^{b}	0.01^{j}
	500	0.15^{def}	0.02^{f}	0.94^{a}	0.07^{defg}	0.09^{d}	0.02^{d}	0.02^{d}	0.01^{d}	0.74^{a}	0.03^{jkl}	0.39^{c}	0.03^{d}	0.13^{cdef}	0.02^{ij}
December	0	0.08^{ef}	0.17^{def}	0.2^{c}	0.03^{efg}	0.12^{d}	0.07^{d}	0.09^{cd}	0.04^{d}	0.17^{b}	0.04^{hijkl}	0.08^{d}	0.04^{d}	0.15^{c}	0.1^{cdefgh}
	200	0.02^{f}	0.01^{f}	0.07^{defg}	0.08^{def}	0.04^{d}	0.04^{d}	0.02^{d}	0.03^{d}	0.06^{fghijk}	0.05^{ghijkl}	0.08^{d}	0.05^{d}	0.1^{cdefgh}	0.1^{cdefgh}
	500	0.06^{ef}	0.06^{ef}	0.07^{def}	0.05^{defg}	0.09^{d}	0.05^{d}	0.1^{cd}	0.05^{d}	0.07^{efghi}	0.05^{ghijkl}	0.09^{d}	0.04^{d}	0.04^{hij}	0.08^{efghij}

Means with same alphabet along the column are not significantly different at ($p>0.05$)

Table 2: Dust collection (in g) at different elevation, under different sieve mesh sizes at different rainfall period

		Dust													
Treatment		**Day 1**		**Day 2**		**Day 3**		**Day 4**		**Day 5**		**Day 6**		**Day 7**	
Season	**Mesh**	**up**	**Down**	**Up**	**Down**	**up**	**down**	**up**	**down**	**up**	**down**	**up**	**down**	**up**	**down**
May	200	0.73^{ij}	0.42^{ij}	0.71^{g}	0.76^{g}	12.86^{c}	17.12^{b}	2.72^{d}	9.46^{b}	2.41^{de}	0.67^{g}	4.53^{ab}	0.48^{jk}	1.17^{hij}	2.52^{efg}
	500	1.26^{hij}	5.75^{bc}	4.07^{cde}	1.62^{fg}	25.6^{a}	24.7^{a}	4.41^{c}	12.01^{a}	1.77^{f}	0.34^{gh}	4.79^{a}	0.85^{hijk}	0.77^{hij}	2.62^{def}
July	200	4.04^{cde}	1.67^{hij}	7.91^{b}	5.73^{c}	1.02^{de}	1.99^{de}	1.43^{defg}	0.92^{efg}	4.29^{b}	1.88^{ef}	1.95^{fg}	1.56^{ghi}	6.85^{b}	3.88^{cd}
	500	4.05^{cde}	1.82^{ghi}	8.57^{b}	4.05^{cde}	2.05^{de}	0.82^{de}	1.81^{de}	0.66^{efg}	4.59^{b}	2.58^{d}	2.82^{def}	1.78^{fgh}	6.82^{b}	3.84^{cde}
August	200	13.68^{a}	5.3^{bcd}	3.48^{de}	0.93^{g}	2.01^{de}	1.46^{de}	1.92^{de}	1.59^{def}	1.65^{f}	1.48^{f}	1.52^{ghij}	1.49^{ghij}	1.24^{ghij}	1.51^{fghi}
	500	6.89^{b}	5.79^{bc}	3.65^{de}	1.32^{fg}	2.46^{de}	0.91^{de}	2.77^{d}	0.96^{efg}	2.74^{d}	1.38^{f}	1.55^{ghi}	1.32^{ghij}	1.81^{fgh}	1.16^{hij}
November	200	3.7^{def}	0.81^{ij}	12.22^{a}	2.81^{ef}	3.4^{de}	0.48^{e}	1.23^{defg}	0.2^{fg}	3.59^{c}	0.25^{gh}	4.63^{ab}	0.62^{ijk}	8.39^{a}	0.61^{hij}
	500	5.13^{bcd}	0.63^{ij}	10.56^{a}	2.84^{ef}	4.41^{d}	0.95^{de}	1.55^{def}	0.58^{efg}	5.97^{a}	0.21^{gh}	3.75^{bcd}	$o.54^{ijk}$	4.73^{c}	0.27^{ij}
December	200	2.01^{fghi}	1.98^{fghi}	7.65^{b}	4.98^{cd}	1.36^{de}	1.09^{de}	1.14^{efg}	0.92^{efg}	4.09^{bc}	1.88^{ef}	3.84^{abcd}	2.07^{efg}	6.85^{b}	3.88^{cd}
	500	3.59^{defg}	2.82^{efgh}	7.98^{b}	3.76^{de}	2.85^{de}	3.05^{de}	2.03^{de}	0.66^{efg}	4.59^{b}	2.58^{d}	4.01^{abc}	3.05^{cde}	6.82^{b}	3.84^{cde}

Means with same alphabet along the column are not significantly different at ($p>0.05$)

REFERENCES

[1]. K. Richards, "Observation and simulation of dew in rural and urban Environments". *Progress in Physical. Geogolgy*. Vol. 28, pp 76-94, (2004)

[2]. S.S. Hosseini, H. Heidari, M.E. Ghobadi, and I. Nosratti, "Effect of dew-irrigation on seed germination"' *Water Supply*, vol. 20, no. 1, pp 269-276. (2019)

[3]. R.B. Husar, J.M. Holloway, D.E. Poll, and W.E. Wilson, "Spatial and temporal pattern of eastern US haziness: a summary", *Atmospheric Environment* vol. 15, pp 1919–1928, (1981)

[4].Agriculture-aajtak.. "Forms of condensation". Available online: https://agriculture-aajtak.blogspot.com/2015/09/3-forms-of-condensation-dew-fog-frost .html. (2015)

[5]. E. A. Santos, T. J. Gillespie, and M. L. Gleason, "Suitability of relative humidity as an estimator of leaf wetness duration",*Agricultural and Forest. Meteorology*, vol. 148, pp 392– 400, (2008)

[6]. J. Schwartz, Presentation at the Conference "Particulate Matter: Atmospheric Sciences, Exposure, and the Fourth Colloquium on PM and Human Health," Pittsburgh, PA, March 31–April 4, 2003

[7]. P. C. Sentelhas, and T. J. Gillespie, "Estimating hourly net radiation for leaf wetness duration using the Penman-Monteith equation", Theoretical Applied Climatology, vol. 91, pp 205–215. (2008)

[8]. J.T. Houghton, G.J. Jenkins, and J.J. Ephraums, *"Climate Change — The IPCC Scientific Assessment,* Cambridge University Press, Cambridge, (1995)

[9]. S. Singh, D. Singh, and V. U. M. Rao, "Fog and dew analysis at Hisar, India". *Journal of.Agrometeorology*, vol. 9, pp 118-21, (2007).

[10]. C.O. Akanni, "Physical Environment" in Onakomaiya, S.O. Odugbemi, O.O. Oyesiku, O.O. and Ademiluyi, I. A, Ogun state Local and Regional perspectives, Centre for sandwich programmes (cesap) Ogun state university, Ago-Iwoye, Pp.14-25 (2000).Ashgate publishing Ltd, Avebury.

[11]. Z. Ulanowski, O.V. Kalashnikova, P.W . Lucas and B. Bercot, "Effect of Charging on Radiative and Transport Properties of Atmospheric Mineral Dust". *Dust Workshop*, Leipzig 15-17 Sept. 2008

[12]. Heather Griffiths., "*Air Pollution on Agricultural Crops", Ontario Ministry of Agriculture, Food and Rural Affairs, Order No. 85-002, (2003)*