Journal of
Environmental & Analytical Toxicology

Ufoegbune et al., J Environ Anal Toxicol 2016, 6:3
DOI: 10.4172/2161-0525.1000374

Research Article Open Access

Determination of Water Use of Three Vegetables; Amaranthus (*Amaranthus cruenthus*), Jutemallo (*Corchorus olitorius*) and Celosia (*Celosia argentea*) at Abeokuta, Nigeria

Ufoegbune GC*, Adebiyi GA and Adekunle AA

Department of Water Resources Management and Agrometeorology, Federal University of Agriculture, Abeokuta, Nigeria

Abstract

An experiment was carried out at the screen house of the college of environmental resources management at the Federal University of Agriculture Abeokuta, Ogun state to determine water use of three vegetable: Amaranthus, Corchorus and Celosia. The experiment was laid out in a completely randomized design (CRD) and was replicated three times with a control. 50 cl of water was applied to the crops at a day interval. Data collected were analyzed making use of ANOVA and statistical analysis system was used to compare the means of the crops planted as a sole of each crop planted and the test was also used to formulate two hypotheses. The result showed that there were no significant differences between the water uses of each vegetable while there were significant differences between the crop coefficients of each vegetable. Based on the experiment carried out, it was observed that the celosia, amaranthus and corchorus needed the same amount of water for their growth. Therefore it is recommended that farmers that practice rainfed agriculture during dry season when there will be or no rain make sure that sufficient water is been supply to the three vegetable crops for rapid growth and optimum yield

Keywords: Water use; Amaranthus; Celosia; Corchorus

Introduction

Vegetables contain 80 to 95 percent water, because they contain so much water, their yield and quality suffers very quickly from drought. When vegetables are sold, a "sack of water" with a small amount of flavoring and some vitamins is being sold. Thus, for good yields and high quality, irrigation is essential to the production of most vegetables. If water shortages occur early in the crop's development, maturity may be delayed and yields are often reduced. If a moisture shortage occurs later in the growing season, quality is often reduced even though total yields are not affected.

Most vegetables are rather shallow rooted and even short periods of two to three days of stress can hurt marketable yield. Irrigation is likely to increase size and weight of individual fruit and to prevent defects such as toughness, strong flavor, poor tip fill, land pod fill, cracking, blossom-end rot and misshapen fruit. Growers often wait too long to begin irrigating, thinking, "It will rain tomorrow". This often results in severe stress for the portion of the field that dries out first or receives irrigation last.

Another common problem is trying to stretch the acreage that can reasonably be covered by available equipment. Both of these practices result in part or the entire field being in water stress.

Amaranthus

The genus *Amaranthus* L. (*Caryophyllales*: *Amaranthaceae*) consists of about 60–70 species, cultivated in many parts of the world. It is a grain native to Mexico and Central America, amaranth was grown for centuries in pre-Columbian America as a staple crop along with corn, several of which are cultivated as leafy vegetables or forage, others for grains production and some are planted as ornamental plants. Unfortunately, some are aggressive weeds that affect many agricultural areas of the world. Despite this, cultivation of amaranth plants has a lot of positive importance in the community. Grain amaranth's balanced amino acid composition is close to the optimum protein reference pattern in the human diet according to FAO/WHO requirements. Mainly, three species of *Amaranthus* L. are commonly cultivated for grain production: *Amaranthu scruentus* L., *Amaranthu scaudatus* L. and A*maranthus hypochondriacus* L. Amaranthus has been also regarded as relatively drought tolerant, thus, suggesting that reasonable yield can be realized with limited irrigation. It is grown as mono crop or intercropped with other staple food crops in traditional farming systems for family consumption and market (The best crop rotation is between small grains or potatoes). It is also an important crop in rain-fed and irrigated vegetable production systems of small scale farmers around urban areas and population centres in the country [1].

Celosia

Celosia argentea belongs to the family malvacea and is one of the important leafy vegetable commonly found in traditional intercropping system of the tropics. It is commonly known as 'Sokoyokoto' or 'Ajefawo' amongst the Yorubas [2] and is a vegetable of high economic value for most rural vegetable farmers [3].

The leaves have also been found to suppress elevation of post prandial blood glucose levels in humans and are rich sources of vitamin A and C [4]. The seeds also possess broad antibacterial properties. In experiments done in Nigeria, *Celosia argentea* was found to suppress weeds more than weeding twice when inter-planted into chewing cane [5].

Celosia argentea is susceptible to pathogens which cause fungal, nematode, bacterial, and viral diseases [6,7]. The productivity of this

***Corresponding author:** Ufoegbune GC, Department of Water Resources Management and Agrometeorology, Federal University of Agriculture, Abeokuta, Nigeria, Tel: 2348039606373; E-mail: gidufoes2000@yahoo.co.uk

Received February 23, 2016; **Accepted** May 05, 2016; **Published** May 10, 2016

Citation: Ufoegbune GC, Adebiyi GA, Adekunle AA (2016) Determination of Water Use of Three Vegetables; Amaranthus (*Amaranthus cruenthus*), Jutemallo (*Corchorus olitorius*) and Celosia (*Celosia argentea*) at Abeokuta, Nigeria. J Environ Anal Toxicol 6: 374. doi:10.4172/2161-0525.1000374

vegetable is therefore largely dependent on the type of disease control strategy employed during cultivation.

Viruses constitute a major limiting factor to vegetable production in most African countries. *Amaranthus mosaic virus* (AMV) was reported for the first time in Nigeria by Taiwo et al. and since then AMV has been found to be highly prevalent in Lagos with an incidence rate of 19.7% [8].

Corchorus

Corchorus olitorus (Jute mallow) belongs to the genus of about 40-100 species of flowering plant in the family Malvaceae. According to Fondio and Grubben, tropical Africa has been suggested as the crops center of origin as a result of huge genetic diversity observed within *C. olitorius* in this region, with a secondary center of diversity in the Indo-Burmese region. Jute mallow is famous for its sturdy natural fibre. The strong, weather proof fibre is used in the manufacturer of everything from burlap sacks to fashions and furnishing. Jute mallow is an important food for many families in the Middle East, Africa, and Asia. The leaves are a rich source of iron, protein, calcium, thiamin, riboflavin, niacin, folate, and dietary fiber. Root scrapings of *C. olitorius* are used to treat toothache in Kenya whereas in Nigeria, concoctions prepared from seeds are used as purgative. The yield and productivity of the crop including *Corchorus olitorius* is plagued by poor cropping system, pest incidence of the soil, therefore there is always the need to ameliorate soil fertility using organic and inorganic sources. Soil organic matter is low in farm lands and there is little amount of nitrogen in the soil of high rainfall areas, therefore it is important to apply organic fertilizer on annual basis for optimum yield of vegetables.

Study area

The experiment was conducted at the screen house of the college of environmental resources management (COLERM) of the Federal University of Agriculture, Abeokuta along Alabata road in Odeda local government area of Ogun state, South Western Nigeria (Figure 1) within the study period of 70 days. It is in derived savannah zone of the country and falls within (longitude 3°24° and 3°26°, latitude 7°13° 30' and 7°14° 30°).

Climatic description of study area

The study area is characterized by a tropical climate with distinct wet and dry seasons. The wet season is associated with the prevalence of the Moist Maritime Southerly Monsoon from the Atlantic Ocean and the dry season by the continental by the Continental North Easterly harmattan wind from Sahara desert. The area is located within a region characterized by bimodal rainfall pattern (commences in March, greater amount at July and September with a short dry spell in August). The long dry period extends from November to March with the annual rainfall ranging between 1400 mm and 1500 mm in Abeokuta and its environs. Furthermore, this region is also characterized by a relatively high temperature with mean annual temperature of about 30°C. The greatest variations in temperature are experienced in July (25.7°C) and in February (30.2°C). The humidity is lowest at the peak of dry season in February (37-54%) and highest at the peak of the rainy season between June and September (78-85%).

Materials and Methods

Experimental treatment

- Seeds of Amaranth belonging to *Amaranthus cruentus* L. were grown in pure stand.
- Seeds of Celosia in pure stand.
- Seeds of Chochorus in pure stand.
- Application of water at the same level to the buckets.

Amaranthus, Celosia and Corchorus were grown in Completely Randomized Design (CRD) with replicates seeds were sown in ten plastic buckets.

Data collection

Determination of water use (ETc): Water uses of container-growing plants were determined by irrigating each plant to container capacity, allowing each to drain completely and then weighing them individually. The plants will then be reweighed after 48 hr. The difference between the beginning and ending weights over the 48 hours period is the water use.

Determination of Evapotranspiration (ETp): Potential Evapotranspiration (ETp) was calculated for each sampling data as a fraction of pan evaporation (Ep). The values of potential evapotranspiration are usually less than or at best equal to those of pan evaporation for the same environment. This is given as: PE=fEp [9]

- where: PE is potential evapotranspiration, Ep is pan evaporation
- f (0.7) is the conversion factor. The values Ep was gotten from school meteorological station for the period of this study.

Determination of Crop Coefficient (Kc): Crop coefficient (Kc) was computed on a weekly basis from 2 weeks after planting date to final harvest as a dimensionless ratio of ETc to ETp according to the equation: Kc=ETc/ETp

Data on morphological trait were collected from the plants using meter rule. The morphological traits are the following:

Plant height: The height was measured from the inflorescence top of the plant to the soil surface in centimeters (cm).

Number of leaves: The number of leaves of the selected plant were counted and recorded.

Meanwhile, the days to flowering were observed as the numbers of days to when all the plant in the experiment flowered.

Data analysis

Data collected was analyzed using ANOVA. Two hypotheses was formulated and tested. The hypotheses are as follows: Hypothesis 1, H0: There is no significant difference between the means of the water use of Amaranthus, Corchorus and Celosia at 0.05 significant levels. H1: There is significant difference between the means of water use of Amaranthus, Corchorus and Celosia at 0.05 significant levels. Hypothesis 2: H0: There is no significant difference between crop coefficient of Amaranthus, Corchorus and Celosia at 0.05 significant levels. H1: There is significant difference between crop coefficient of Amaranthus, Corchorus and Celosia.

Results

The result are presented below inform of tables and figures. Table 1 shows the PE, ETc and Kc for Amaranthus, Celosia and Corchorus.

Figure 2 showed the ETc of three vegetables against weeks after planting. This revealed that the three vegetable increase their water

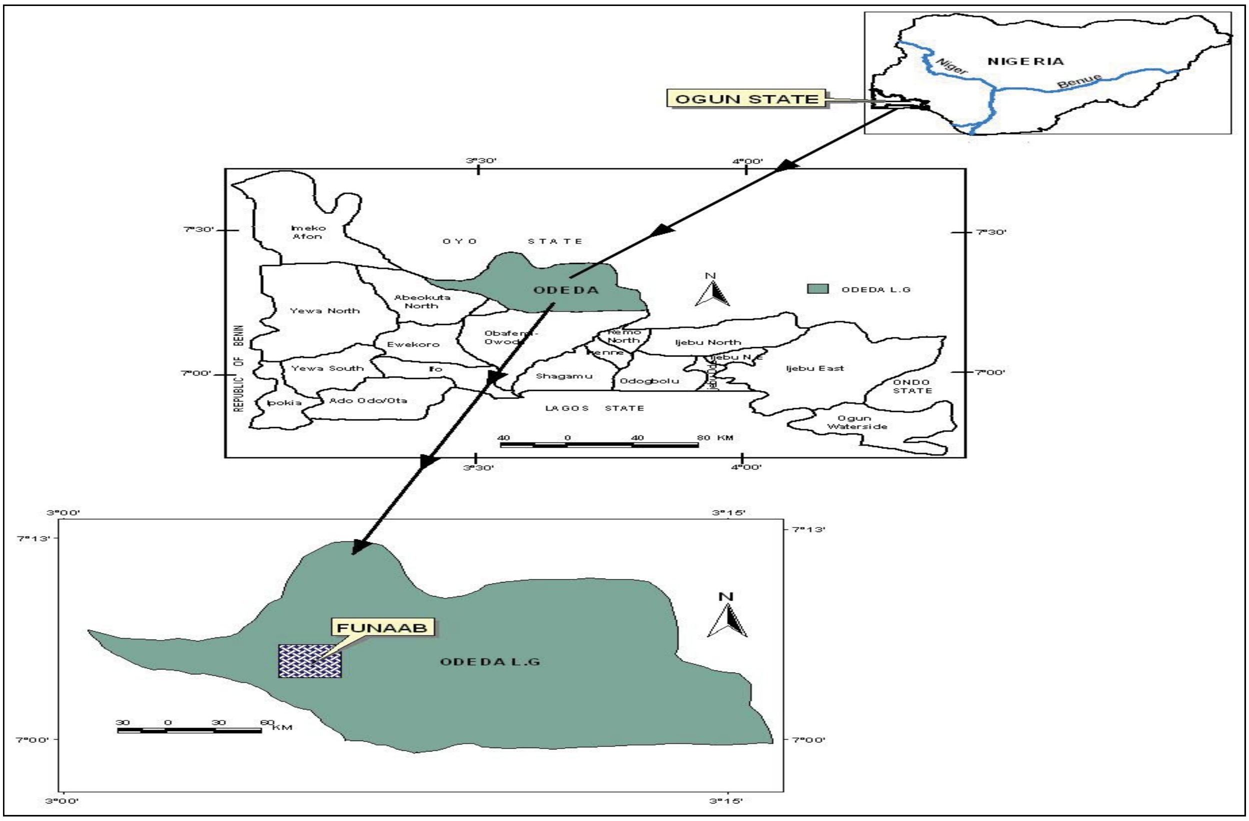

Figure 1: Map of study area.

Date	PE	Amaranthus		Celosia		Corchorus	
		ETc	Kc	ETc	kc	ETc	kc
21/5/15	2.1	0.30	0.14	0.40	0.19	0.36	0.17
23/5/15	2.8	0.40	O.14	0.56	0.20	0.58	0.20
25/5/15	2.8	0.50	0.17	0.66	0.23	0.68	0.24
27/5/15	2.8	0.50	O.17	0.68	0.24	0.70	0.25
29/5/15	2.8	0.50	0.17	0.70	0.25	0.72	0.26
31/5/15	2.8	0.50	0.17	0.70	0.26	0.80	0.28
2/6/15	0.7	0.12	0.17	0.22	0.31	0.24	0.34
4/6/15	1.4	0.27	0.19	0.50	0.35	0.52	0.37
6/6/15	1.4	0.30	0.21	0.55	0.39	0.60	0.42
8/6/15	2.8	0.80	0.28	1.26	0.45	1.50	0.53
10/6/15	1.4	0.50	0.35	0.70	0.50	0.90	0.64
12/6/15	1.4	0.80	0.50	0.85	0.59	1.00	0.71
14/6/15	2.1	1.20	0.57	1.40	0.66	1.60	0.76
16/6/15	0.7	0.50	0.71	0.50	0.71	0.60	0.85
18/6/15	2.8	2.20	0.78	2.30	0.82	2.50	0.89
20/6/15	0.7	0.60	0.85	0.65	0.92	0.70	1.00
22/6/15	1.4	1.26	0.90	1.42	1.01	1.50	1.07
24/6/15	2.1	2.20	1.04	2.10	1.09	2.35	1.11
26/6/15	2.1	2.30	1.09	2.30	1.14	2.40	1.16
28/6/15	2.8	3.20	1.14	3.25	1.16	3.35	1.9
30/6/15	1.4	1.60	1.14	1.64	1.17	1.69	1.20
2/7/15	0.7	0.82	1.17	0.83	1.18	0.83	1.18
4/7/15	2.1	2.50	1.19	2.52	1.15	2.45	1.16

Date	PE	Amaranthus		Celosia		Corchorus	
		ETc	Kc	ETc	kc	ETc	kc
6/7/15	2.1	2.52	1.20	0.50	1.19	2.40	1.14
8/7/15	0.7	0.82	1.17	0.80	1.14	0.70	1.10
10/7/15	0.7	0.80	1.14	0.79	1.12	0.65	0.92
12/7/15	1.4	1.55	1.10	1.50	1.07	1.25	0.89
14/7/15	2.1	2.40	1.04	2.10	1.00	1.75	0.83
16/7/15	0.7	0.70	1.00	0.60	0.85	0.50	0.71
18/7/15	1.4	0.25	0.89	1.12	0.80	0.90	0.64
20/7/15	1.4	1.24	0.88	1.08	0.77	0.80	0.57
22/7/15	0.7	0.60	0.85	0.50	0.70	0.30	0.43
24/7/15	2.1	1.70	0.80	1.40	0.66	0.80	0.38
26/7/15	2.1	1.50	0.71	1.20	0.57	0.70	0.33
28/7/15	2.1	1.30	0.61	1.00	0.47	0.60	0.28
30/7/15	0.7	0.4	0.57	0.25	0.35	0.18	0.25

Table 1: PE, ETc and Kc for Amaranthus, Celosia and Corchorus.

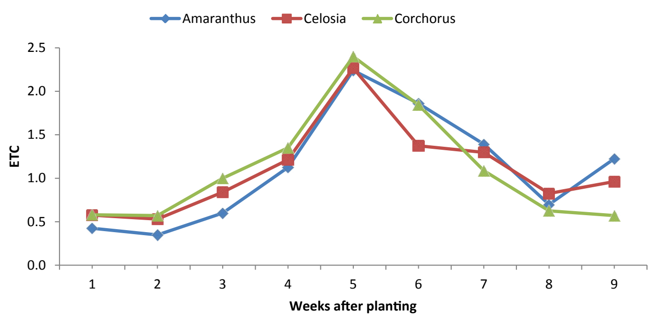

Figure 2: Water use (ETc) of three vegetable (Amaranthus, Celosia and Corchorus).

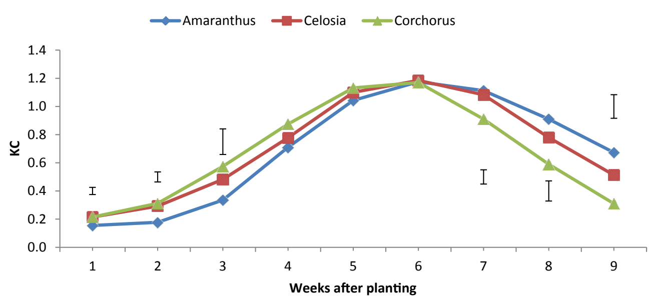

Figure 3: Crop coefficient (K_c) of the three vegetables (Amaranthus, Celocia and Corchorus).

use in their vegetative growth until they rich their peak while there is decrease in their water use period senescence. This graph also indicated that ETc of the three vegetables are not significantly difference. Therefore, their water use is the same.

This graph above (Figure 3) indicated that first two weeks after planting, the Kc of celocia and corchorus are not significantly difference but the Kc of amaranthus was different while third week there is significant difference in the Kc of three vegetables. It was also shown that from fourth weeks to sixth weeks, there is no significant difference in Kc of three vegetables while from seventh weeks up to ninth weeks there was significant different in Kc of three vegetable.

Discussion

The study examined the determination of water use and crop coefficient of three leaves vegetable with three treatments of sole amaranthus, sole closia and sole corchorus. Water use of container-growing plants were determined by irrigating each plant with 50 cl of water to container capacity, allowing each to drain completely and then weighing then individually. The plants will then be reweighed after 48 hours. The difference between the beginning and ending weights over the 48 hours period is the water use. Crop coefficient (Kc) was computed on a weekly basis from 2 weeks after planting date to final harvest as a dimensionless ratio of ETc to ETp according to the equation:

$$Kc = ETc/ETp.$$

It was revealed that there was increment of water use of three vegetable in their vegetative growth and decrease gradually period senescence which is agreement with [10-15]. It was also revealed that water use (ETc) is not significantly different in sole of each vegetable. The mean value of each vegetable carries the same alphabet (a) which indicate that there is no significant different between the three vegetable [16-23]. The graphs also indicate that from the 1st week after planting up to 9th week the three vegetables requires the same amount of water for their life span.

Also, the crop coefficient (Kc) of three vegetable shows that they requires much more water during the vegetative and flowering stages than at emergence and senescence [10]. The graph shown that for the first two week after planting, the Kc celosia and corchorus are the same but the Kc of amaranthus is quite different. It was also revealed the Kc of three vegetable are quite different in 3rd weeks while from forth week to sixth week there is no significant different in the Kc of three vegetable [24-28].

The Kc of amaranthus and celosia are the same at seventh week while that of corchorus is different. The last two week of their life span the Kc of the three vegetable are different from each other. The plant height also shows that there is increase in the height of each vegetable from the first week after planting up to 12th week. Also, there are variations in the number of leaves of each vegetable from the 1st week after planting up to 12th week. This shows that as the plant height increases, the number of leaves also increases.

References

1. Ojo OD (2001) Density and cutting height affect the production of celosia

(Celosia argentea L.). Journal of Vegetable Crop Production 7: 45-55.

2. Schippers RR (2000) African indigenous vegetables. An overview of the cultivated species. Natural Resources Institute. ACP-EU Technical Centre for Agricultural and Rural Cooperation. Chatham, UK, pp: 16-23.
3. Akinfasoye JA, Ogunniyan DJ, Akanbi WB, Olufaji AO (2008) Effect of organic fertilizer and spacing on growth and yield of lagos spinach (*Celosia argentea*). J Agric Soc Res 8: 70-77.
4. Innami S, Ishida H, Nakamura K, Kondo M, Tabata K (2005) Jews mellow leaves (*Corchorusolitorius*) suppress elevation of postprandial blood glucose levels in rats and humans. Int J Vitamin Nutr Res 75: 39-46.
5. Busari LD, Misari SM, Olaniyan GO, Indarubu AA (1997) Weed management systems in chewing cane production in the inland valleys of Nigeria. In: Adipala E, Tusiime G, Okori P (Eds.). Proceedings of the 16th Biennial Weed Science Society Conference for Eastern Africa. WSSEA, Kampala, pp: 97-102.
6. Broadbent P, Baker KF, Franks N, Holland J (1977) Effect of Bacillus spp. on increased growth of seedlings in steamed and in non-treated soil. Phytopathology 67: 1027-1034.
7. Nyamupingidza TN, Machakaire V (2003) Virus diseases of important vegetables in Zimbabwe. In: Hughes, Odu J (eds) Plant Virology in Sub-Saharan Africa, Proc Conf Organized by IITA, Jd'A, International Institute of Tropical Agriculture, Ibadan, Nigeria, pp: 397-406.
8. Taiwo MA, Owolabi AT (2004) Occurrence and prevalence of viruses of leafy vegetables in Lagos, Nigeria. Global J of Pure and Appl Sci 10: 61-67.
9. Allen RG (1986) A Penman for all seasons. Journal of Irrigation and Drainage Engineering 112: 348-368.
10. Fasinmiriin JT, Reichert JM, Oguntunde PG, Ajayi AE (2015) Greenhouse evapotranspiration and crop factor of *Amaranthus cruentus* grown in weighing lysimeters. African Journal of Agricultural Research 10: 3453-3461.
11. Aboukhaled A, Alfaro A, Smith M (1982) Lysimeters. FAO Irrigation and drainage paper 39. Food and Agriculture Organization of United Nations. Rome, Italy.
12. Allen RG, Pereira LS, Raes D, Smith M (1998) Crop evapotranspiration. Guidelines for computing crop water requirements. FAO Irrigation and Drainage paper 56. Food and Agriculture Organization of United Nations. Rome, Italy.
13. Akoroda MO (1998) Cultivation of jute mallow (*Corchorusolitous* L.) for edible leaf in Nigeria. Tropical agriculture 65: 279-299.
14. Blaney HF, Criddle WD (1950) Determining water requirements in irrigated areas from climatological and irrigation data. US Dept Agric Soil Cons Serv SCS-TP-96, p: 48.
15. Breene WM (1991) Food uses of grain amaranth. Cereal Foods World 36: 426-430.
16. Bressani R, Sanchez-Marroquin A, Morales E (1992) Chemical composition of grain amaranth. Food Rev Int 8: 5-21.
17. Brouwe C, Heibloem M (1986) Irrigation water needs. Irrigation water management: Training Manual No. 3. Food and Agriculture Organization of United Nations. Rome, Italy.
18. Chalmers DJ, Andrews PK, Harris KM, Cameron EA, Caspari HW (1992) Performance of drainage lysimeters for evaluation of water use by Asian pears. Horticultural Science 27: 263-265.
19. Chow VT (1964) Handbook of Applied hydrology. McGraw-Hill Book Co, New York.
20. Fondio L, Grubben GJH (2004) Corchorusolitorius L. In: Grubben GJH, Denton OA (eds.). PROTA 2: Vegetables/Légumes. PROTA, Wageningen, The Netherlands.
21. Grattan SR, Bowers W, Drong A, Snyder RL, Carroll JJ, et al. (1998) Crop coefficient: The key to improving crop yield. Irrigation Journal.
22. James LG (1987) Principles of farm irrigation system and design. John Wiley and Sons.
23. Kirtikar KR, Basu BD (1918) Indian medicinal plants. Jayyed Press, New Delhi.
24. Laux M (2005) Amaranth Agricutural Marketing Resource Center.
25. Monteith JL (1965) Evaporation and environment. The State and Movement of Water in Living Organisms. Symp Soc Exp Biol 19: 205-234.
26. Seymour T (2002) Foraging New England. Falcon Guides. Globe Pequot Press.
27. Shih SF, Allen LH, Hammond LC, Jones JW, Rogers JS, et al. (1981) Comparison of Methods of Evapotranspiration Estimates. American Society of Agricultural Engineers Summer meeting, Orlando, pp: 81-2015.
28. Tyagi NK, Sharma DK, Luthra SK (2000) Evapotranspiration and crop coefficients of wheat and sorghum. Journal of Irrigation and Drainage Engineering 126: 215-222.