Evaluating Perlite as a Soil Additive to Save Water in Urban Landscapes

Gulf Perlite LLC

Manufacturers of Expanded Perlite For Horticultural Applications

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AGRICULTURE FOR TOMORROW

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Report for Technical Services to:

Gulf Perlite LLC

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On behalf of:

Gulf Perlite LLC

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Manufacturers of Expanded Perlite For Horticultural Applications

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Gulf Perlite LLC Dubai Factory

1. Background

Gulf Perlite LLC

Gulf Perlite LLC manufactures and supplies expanded Perlite products for Landscaping, Agricultural, Hydroponics, Constructional, Cryogenic, Filtration & Industrial applications (Photo 1). Their state-of-the-art factory in Techno Park, Jebel Ali serves the entire Gulf region & Middle East. It delivers one of the world's most premium expanded Perlite.

Perlite is a 100% natural, chemically-inert, sterile, inorganic, porous volcanic rock, used as a physical soil enhancer & the ultimate growing medium for agricultural, landscaping and hydroponics applications. Perlite is an ideal substrate for growing all indoor & outdoor plants and improves soil aeration and drainage. Perlite has very high Water Holding Capacity which adds permanent moisture to the soil and reduces irrigation water & maintenance costs by 50%.

Expanded Perlite bulk density is 80-90kg/m³, thus Perlite is the perfect solution for lightweight planting soil mixes for roof/podium gardening, vertical gardens & planter boxes. Perlite can be used as a lightweight backfill, lightweight concrete or as a lightweight loose fill for planter boxes.

Gulf Perlite Hydro-Turf© is superior in results and extremely cost effective versus other imported water saving soil additives, with double efficiency (very high water holding capacity due to its porous surface after expansion) and long-lasting durability (One-time application, will not decay or decompose) that will guarantee 50% water irrigation reduction starting from the second month of application. Perlite lasts for years without maintenance or replenishment. Perlite is a Natural Volcanic mineral that has been used for Horticultural applications worldwide over the last seventy years.

International Center for Biosaline Agriculture (ICBA)

The International Center for Biosaline Agriculture (ICBA) is a non-profit, international center of excellence for research and development in marginal environments. ICBA has projects in the Middle East and North Africa (MENA); the Gulf Cooperation Council countries; Central Asia and the Caucasus; South and South East Asia, and sub Saharan Africa. In summary, the research programs at ICBA aim to improve agricultural productivity and sustainability in marginal environments. This multi-pronged approach to strengthening the agricultural sector to expand food production through improved and better access to technology, improved germplasm, policies, strategies and programs, is critical to achieve greater water conservation, environmental sustainability, and income and food security.

Photo 1. PERLITE HOUSE. Parts of a residence where Perlite can be used.

ICBA Major Areas of Research Linked to Gulf Perlite LLC

Gulf Perlite is closely linked with ICBA's major research objectives which are aimed at addressing the challenges in marginal environments. Within these marginal environments, ICBA provides technical support on sustainable production, efficient water use, environmental impacts, natural resources assessment and management, capacity development and policy and governance.

2. ICBA's Role as the Technical Assistant

2.1. Technical Assistance to Gulf Perlite LLC: Testing Perlite to Save Irrigation Water in Landscaping

ICBA's discussion and collaboration with Gulf Perlite has led to an agreement where ICBA provides technical assistance to Gulf Perlite in assessing Perlite usage for water saving in landscaping (turf grass & shrubs). Gulf Perlite has requested ICBA to prepare a proposal for the technical assistance it can provide in testing Perlite in landscaping for water saving.

2.2. Objective

To assess Perlite in terms of water saving (turf and shrub).

2.3. Methodology

2.3.1. Laboratory Test

Preliminary laboratory tests were performed to pre-test the physical properties of the Perlite material with respect to its effect on moisture retention characteristics, aeration capacity and permeability.

Perlite was tested in the laboratory for water retention capacity at 1/10 bar and 15 bar using pressure membrane apparatus (table 1).

Table 1. Perlite water retention determined with pressure membrane apparatus at 1/10 and 15 bar

Pressure	1/10 bar	15 bar
Water retention % (by weight)	137.48	86.97

2.3.2. Perlite Testing in the Field

A field trial was conducted to test Perlite under two irrigation water rates to determine water saving for turf and shrubs, as described below and detailed in photo 2.

- Soil: Sweet red sandy soil.
- Perlite: 0.1-2.0 mm.
- Treatments: 2 (with and without Perlite).
- The vegetation: Turf grass and Shrub - Bougainvillea (0.5 m distance between plants).
- Turf grass was grown on 6 plots (each plot size = 2m x 2m = 4 m^{-2}).
- 3 plots without Perlite receiving 10L m^{-2} Day^{-1}, using sprinklers twice a day.
- 3 plots with Perlite @ 50 L m^{-2} receiving 5L m^{-2} Day^{-1} using sprinklers twice a day.
- The shrubs were grown on both sides of the turf grass plots.
- One side of shrubs received Perlite @ 15 L per shrub (mixed up to 50 to 60 cm depth) and received 7.5 L of water per day in two cycles through drip irrigation.
- Other side of shrubs (without Perlite) received 15 L of water per day in two cycles through drip irrigation.
- Basal application of cow manure @ 3-5 kg/m^2) plus standard NPK application.
- Irrigation water (treated waste water).

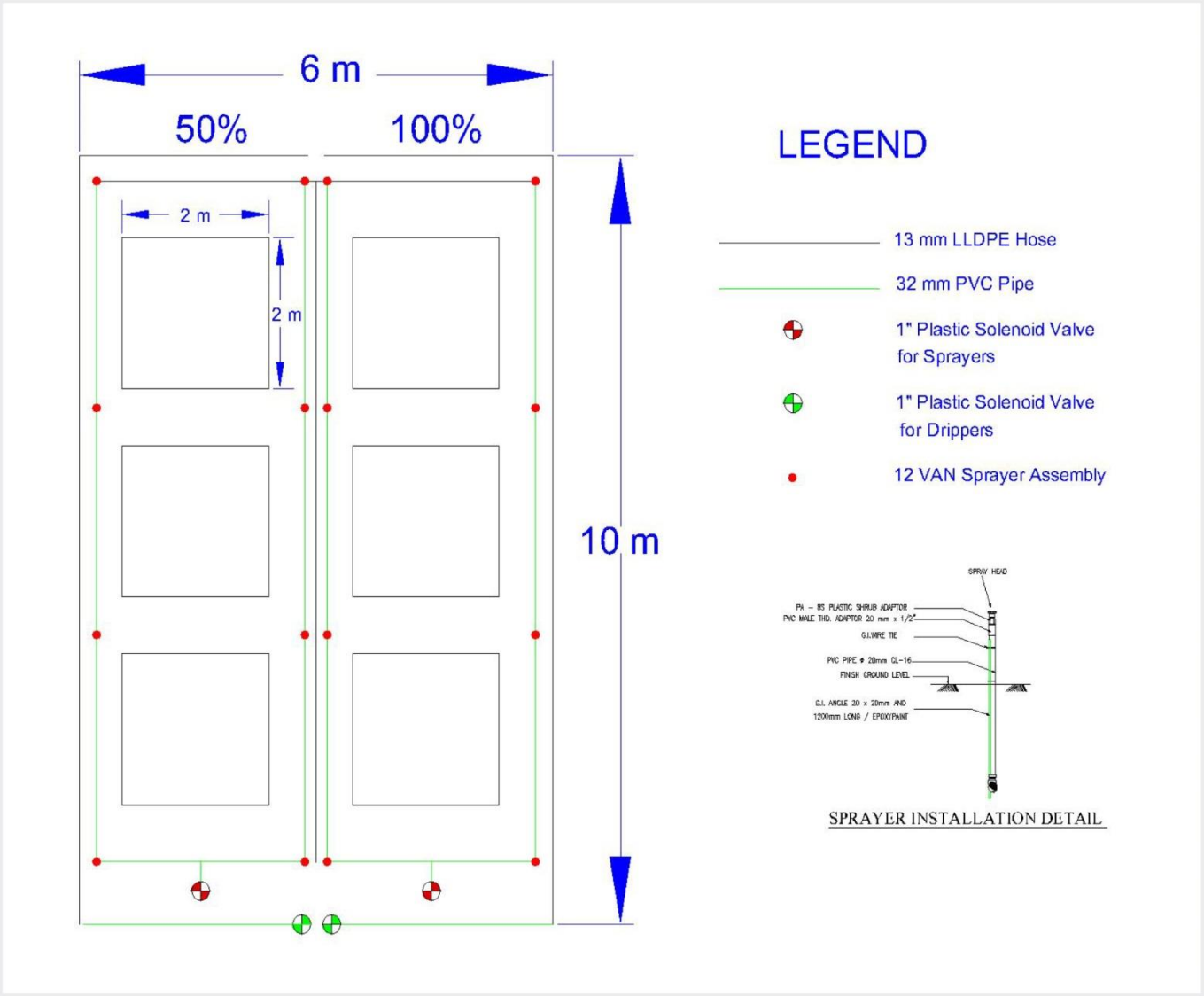

Photo 2. Experimental plan design. Plot size= 2m x 2m = 4m^2. Distance between vertical plots = 80 cm. Horizontal distance between plots = 100m. Squared plots planted with turf and the edges planted with bougainvillea.

Field preparation to test Perlite at ICBA station

The field was cleaned, leveled and irrigation system was installed (Photo 3).

Photo 3. Preparation of the field for the installation of the experiment.

In cooperation with the Gulf Perlite team, the basal cow manure was applied to the plots at appropriate rates (3-5 kg/m^2) and the Perlite was added in one of the sides (3 plots of 2m x 2m size) @ 50 L m^{-2} (Perlite treatment) and mixed properly, while the opposite side was without addition of Perlite as control treatment (Photo 4). Once the plots were ready, the turf grass was fixed on the plots and was irrigated abundantly to allow the establishment of the grass (Photo 5).

Photo 4. Basal application of cow manure @ 3-5 kg/m^2 for all plots and application of Perlite @ 50 L m^{-2} in one side only (Perlite treatment).

The edges of the plots were prepared for the plantation of shrubs (bougainvillea) with two treatments. One side with the application of Perlite @ 15 L per shrub (mixed up to 50 to 60 cm depth) (Perlite treatment), the other side without (Control), Photo 6.

During the first two weeks after plantation, both grass and shrubs received full water application (100%) for both treatments (with and without Perlite) to ensure the establishment of the experiment. Then the 3 plots without Perlite received 10L m^{-2} Day^{-1} using sprinklers twice a day, while the 3 plots with Perlite received 5L m^{-2} Day^{-1} using sprinklers twice a day. The bougainvillea planted with Perlite received 7.5 L of water per day in two cycles through drip irrigation and the ones without Perlite received 15 L of water per day in two cycles through drip irrigation.

Photo 5. Planting of the turf grass.

Photo 6. Planting bougainvillea on the edges. One side with application of Perlite @ 15 L per shrub (mixed up to 50 to 60 cm depth), one side without.

Photo 7. Experimental site of Perlite testing at ICBA.

2.4. Monitoring and Evaluation of Field Trial

The growth of the turf grass and bougainvillea was monitored over the period of the experiment and pictures of the experimental site were taken every month (Photo 8).

Photo 8. The experiment status progression during the period April- December 2015 and the period January- May 2016.

Mr. Konstantinos Mitsiou, Managing Partner of Gulf Perlite LLC, visited ICBA with his team in June 2015 to check the experimental site and discussed further collaboration with the center (Photo 9).

Photo 9. Visit of Mr. Konstantinos Mitsiou, Managing Partner of Gulf Perlite LLC to ICBA and the experimental site.

The turf grass was harvested periodically (when at appropriate height) over a period of 12 months (Photo 10). Grass biomass was recorded for both treatments and collected data were analyzed. The growth of shrubs (height and canopy diameter) was monitored periodically over a period of 9 months and branches were pruned twice to keep plants healthy (Photo 11).

Photo 10. Grass cuttings during experimental period.

Photo 11. Pruning of bougainvillea branches in January 2016.

The fresh weight of the turf grass cuts during the experiment period is presented in figure 1. A one kg sample was taken from each cut and dried in the oven for water content estimation. The data are presented in figure 2.

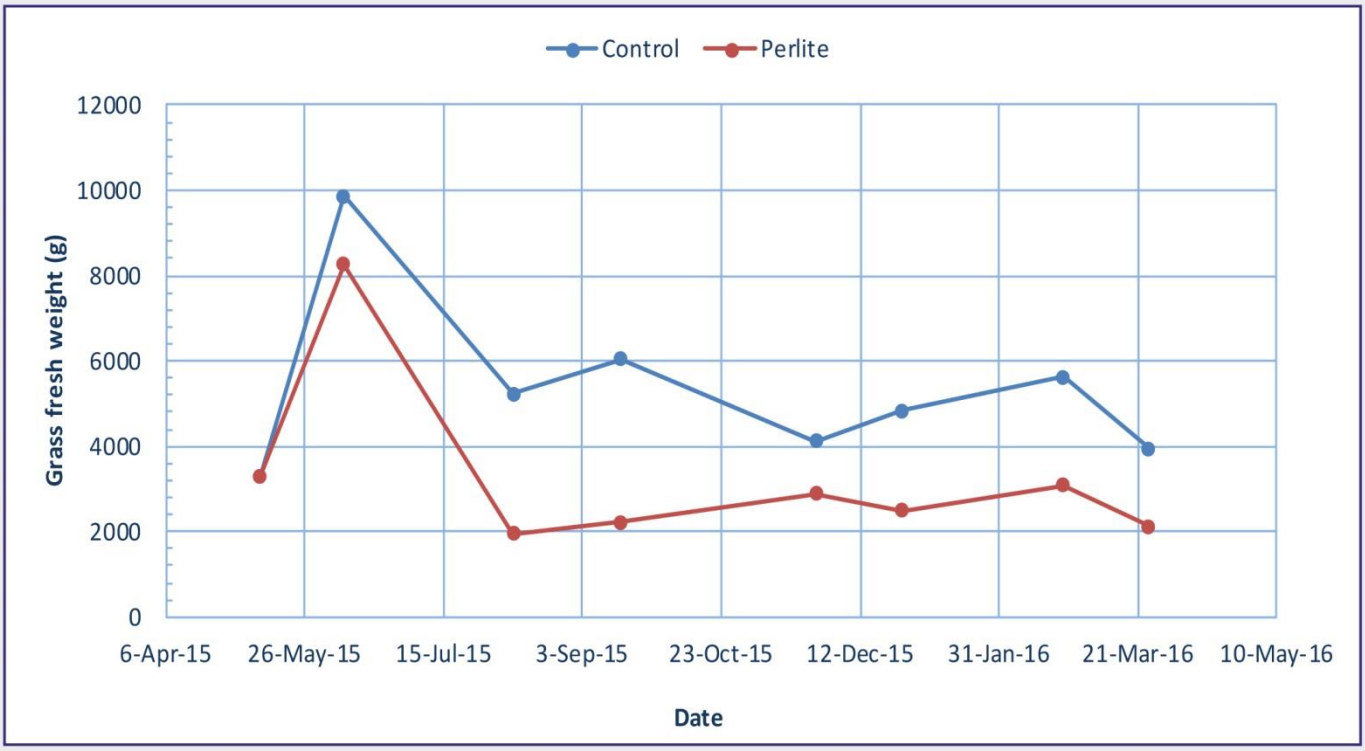

Figure 1. Fresh biomass of turf grass cuts (in grams) during the experiment period (April 2015-March 2016) for the Control (100% water requirement irrigation: 10 L m^{-2} Day^{-1}) and the Perlite treatment (50% water requirement irrigation: 5 L m^{-2} Day^{-1}).

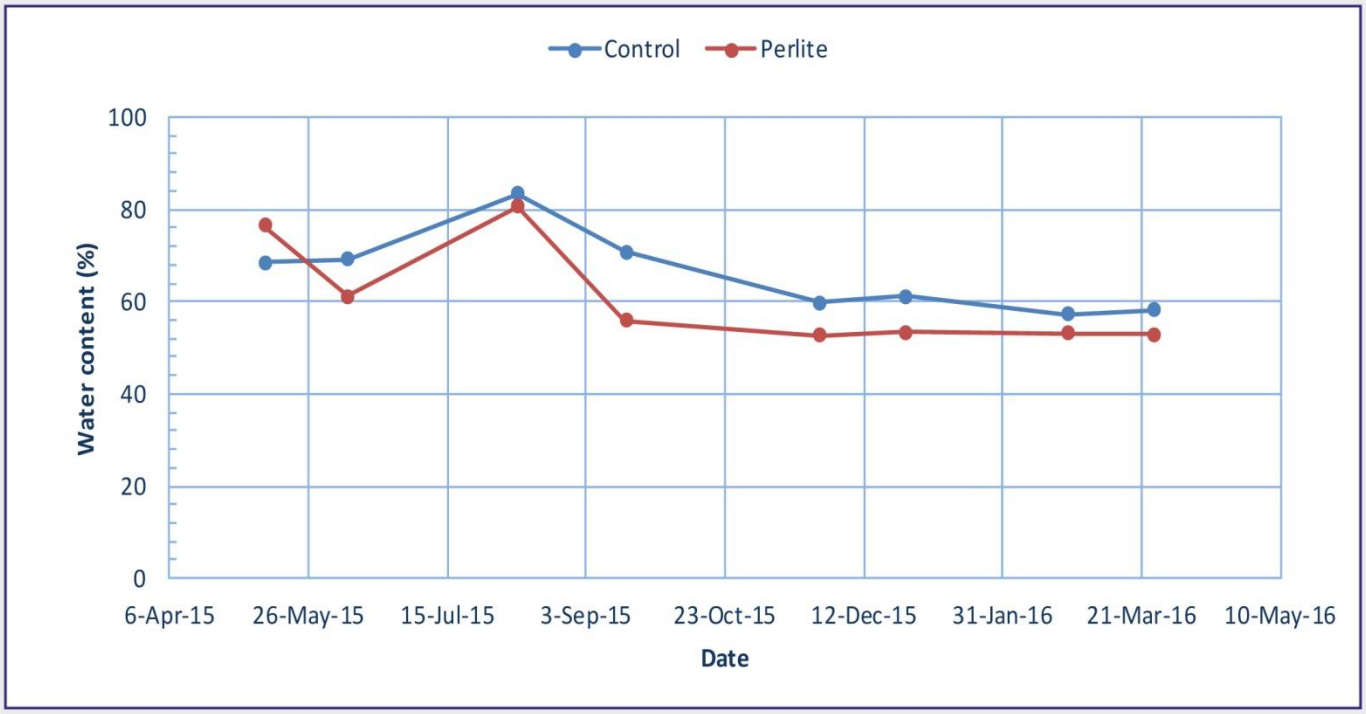

Figure 2. Water content of the turf grass based on the oven dry weight of grass cut during the experiment period for the Control (100% water requirement irrigation: 10 L m^{-2} Day^{-1}) and the Perlite treatment (50% water requirement irrigation: 5 L m^{-2} Day^{-1}).

The height and canopy diameter of the bougainvillea shrubs recorded during the experiment period are presented in figures 3-4.

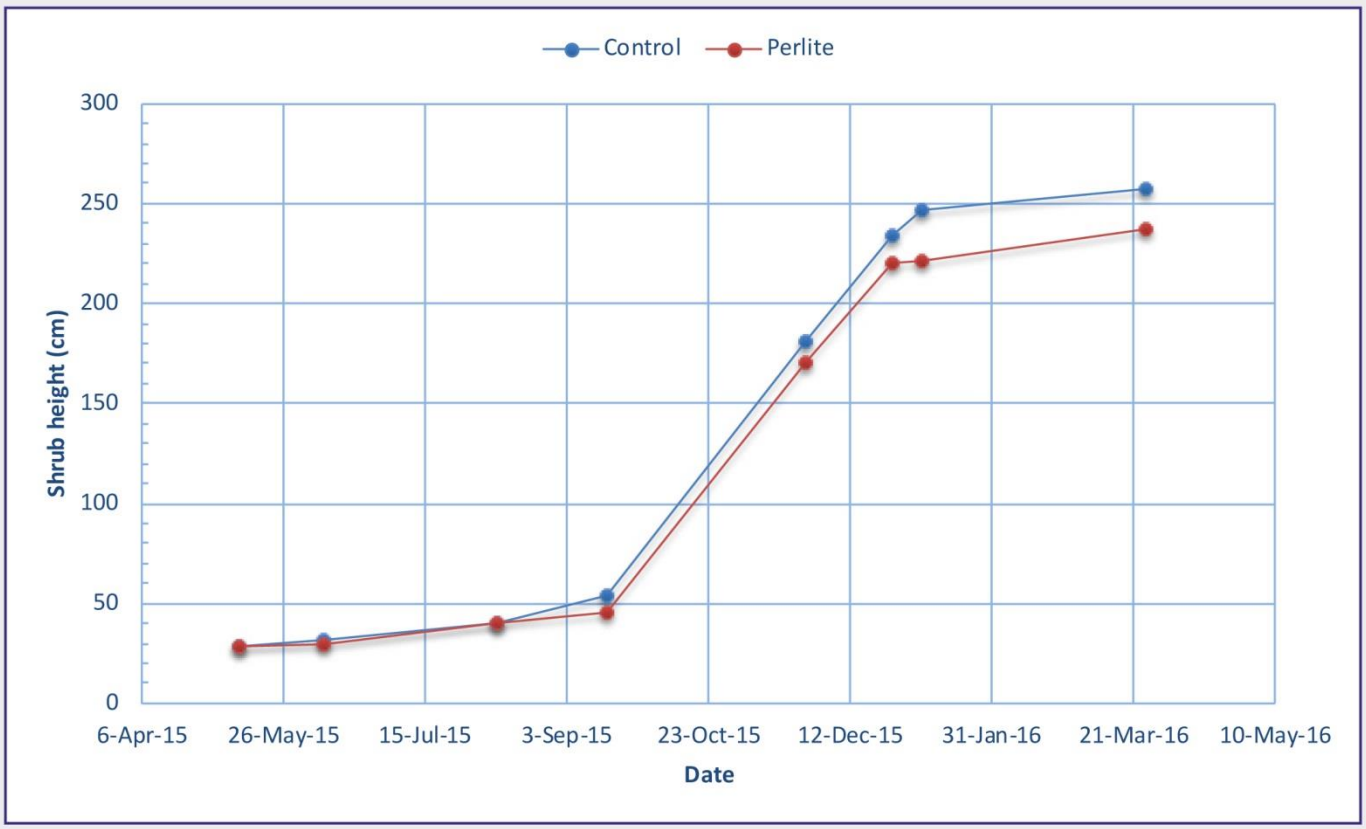

Figure 3. Bougainvillea shrubs' height recorded during the experiment period in both treatments with Perlite (50% water requirement irrigation: 5 L m^{-2} Day^{-1}) and without Perlite (Control, 100% water requirement irrigation: 10 L m^{-2} Day^{-1}).

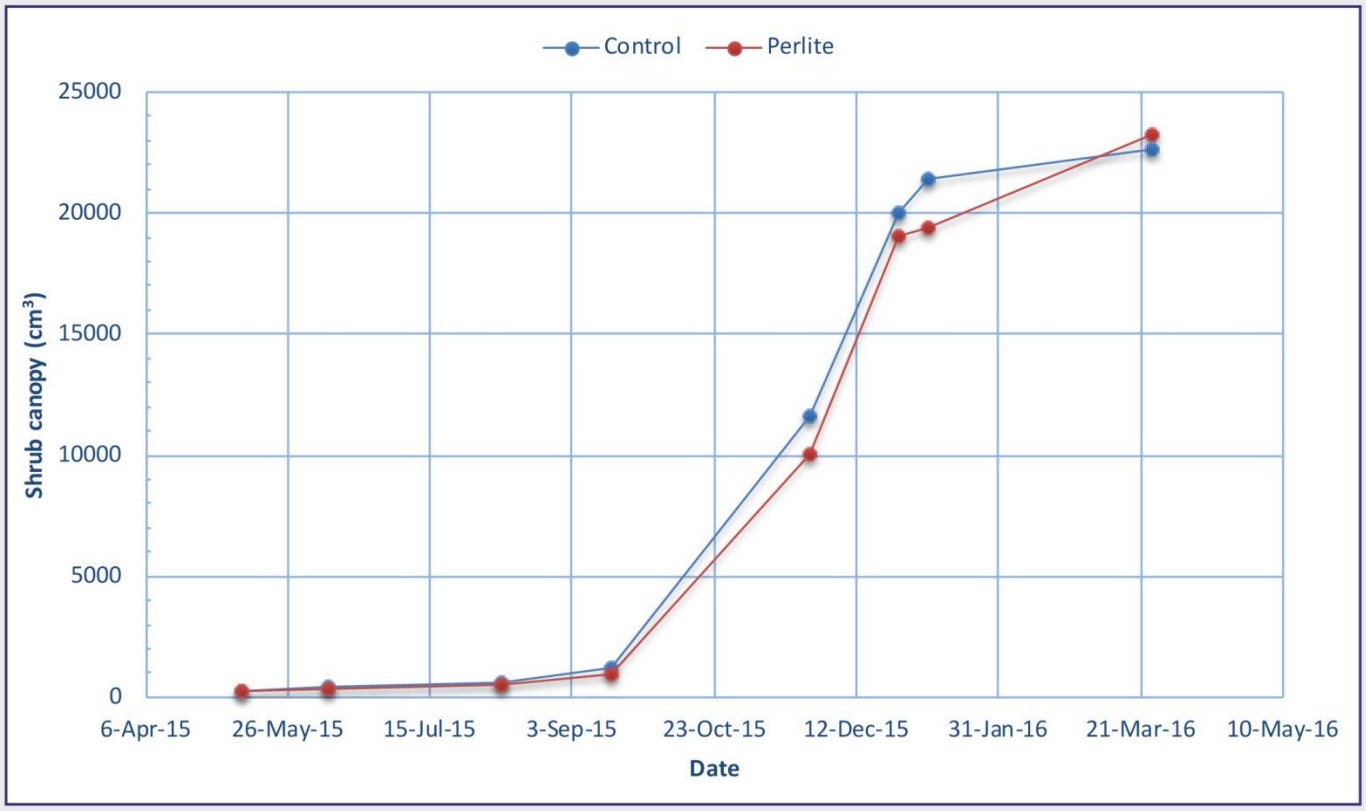

Figure 4. Bougainvillea shrubs' canopy calculated based on height and diameter recorded during the experiment period in both treatments with Perlite (50% water requirement irrigation: 5 L m^{-2} Day^{-1}) and without Perlite (Control, 100% water requirement irrigation: 10 L m^{-2} Day^{-1}).

2.5. Evaluation of the Performance of Perlite in Terms of Water Saving and Biomass Production

The use of Perlite to cut down the irrigation water by 50% for landscaping in sandy soil, showed positive and promising results in terms of water saving and establishment of healthy landscape. Using Perlite and reducing irrigation by 50% was documented with minor effects on plants' growth during the hot season (July-August) on both the turf grass and the bougainvillea. Growing on sand mixed with Perlite and irrigated with 50% irrigation water requirement showed similar growth to the grass and shrubs grown without perlite and irrigation with 100% irrigation water requirement. The growth and the condition of both fields irrigated with 50% (Perlite treatment) and 100 % (control) water requirement were similar, even during the hot season.

The results are positive and promising in terms of water saving for landscaping and may be tested further for the effect on growth of different crops. Irrigation water can be saved by 50% with the addition of perlite in sandy soils without losing biomass, compared to areas where 100% irrigation is applied.

About ICBA

ICBA supports decision-makers, researchers, and farmers and facilitates access to its technologies worldwide. In recent years, thousands of farmers have benefited from this work and improved their knowledge and incomes in different countries. As ICBA is a non-profit research organization, these achievements and progress have been made possible by the strategic thinking and leadership of its key long-term core partners: the UAE Government (through the Ministry of Climate Change and Environment and the Environment Agency - Abu Dhabi) and the Islamic Development Bank.

To continue its mission of helping vulnerable farmers in marginal environments around the world, ICBA works on diversifying sources of funding for agricultural research and innovation through different initiatives, including establishing a *Waqf* and an endowment fund.

As ICBA implements its strategy for 2013-2023, it will continue to work towards establishing itself as a global knowledge hub on sustainable agriculture and food, water and nutrition security.

ICBA is committed to making sure that its knowledge and innovations are freely available to everyone, today and tomorrow, for the benefit of all people, but especially the poor and the most vulnerable living in marginal environments around the world.