

Mulching effect on selected ornamental plants

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Abstract

To further enhance the understanding of cultural needs and to promote efficient use of expensive water resources in ornamental plant production, it is important to conduct studies on fertilizer and irrigation requirements, identification and control of insect pest and disease and water conservation measures under local climatic conditions. The study reported in this paper was initiated in June 2002 to determine the effects of mulching on the growth and greenery impact of four proven adaptable introduced ornamental plants (*Vitex agnus castus* (VA), *Caesalpinia mexicana* (CM), *Myoporum parvifolium* (MP) and *Rosmarinus officinalis* (RO)). Organic mulches (processed bark or compost) procured locally were applied to the soil surface immediately after planting. Periodic data recorded during the first year after planting indicated significant individual effects (mulches and species). However, the mulch x species interactions were not significant at $P=0.05$. The processed bark was the better than compost in increasing plant height and canopy in MP and RO. However, VA plants in bark mulch had increased seedling height and larger canopies than those in unmulched plants. CM plant height was not affected by mulching but canopy increased due to surface mulching. The root zone soil moisture regimes were almost similar in all treatments.

Key words: Ornamental plants, drought, mulching effect, plant growth.

Introduction

Kuwait is an arid country with a severely harsh climate. The summer months are extremely hot with frequent sandstorms. Winter is mild with low, erratic rainfall (an average annual precipitation of around 100 mm). The mean temperatures in January and July are 8 and 44°C, respectively (Abdal *et al.*, 1993). Humidity is low (13% in June) and evaporation is extremely high (as high as 24.3 mm/day in summers). The virgin soil of Kuwait is nonsaline, moderate to very shallow in depth, sandy to sandy-loam in texture and has low water and nutrient retention capacities. Such conditions impose severe water stress on plants. Therefore, it is a common practice among landscape maintenance engineers to apply excess irrigation water to compensate for extreme arid conditions and low water retention capacities of the soils. While supplemental irrigation has contributed to an increase in greenery development, it has led to salinization of arable lands and adversely affected the long-term sustainability of plant production activities in the country. Additionally, it has resulted in the degradation of land and water resources in the country.

The Aridland Agriculture and Greenery Department of KISR has been continuously making efforts to introduce, test and naturalize drought- and heat-tolerant plants and standardization of water conserving cultural practices (Taha *et al.*, 1988, Houkal *et al.*, 1988; Bhat 1997; Al-Zelzalah *et al.*, 2002). Recently, 30 new ornamental plants were introduced and evaluated in agricultural and bioremediated soils for their adaptability and growth performance under Kuwait's climate (Suleiman *et al.*, 2002). Majority of these plants showed good potential for growing under the local harsh climate. While these studies expanded the NGP plant palette, they also called for additional research efforts to optimize cultural practices to optimize their greenery and visual impacts (KISR, 1996). Proper irrigation scheduling based on

actual water needs and the use of surface mulches creates favorable soil moisture regimes; improve soil structure and moderate soil microclimate to support optimal plant growth and development (Robinson, 1988). The potential of organic mulch such as processed bark and composed green wastes to establish favorable water and nutrient regimes under harsh climatic conditions has also been recognized by a number of researchers (Tukey and Schoff, 1963; Greenly and Rakow, 1995; Dick and McKoy, 1993; Iles and Dosmann, 1999). In view of the benefits of application of organic surface mulch, the effects of two organic mulches were investigated in the present study.

Materials and methods

Plant Materials: Four proven potential introduced plant species, two each of shrubs (*Vitex agnus castus*, VA and *Caesalpinia mexicana*, CM), and ground cover (*Myoporum parvifolium*, MP and *Rosmarinus officinalis* RO), were selected for the mulch study. Hardened plants in 10 cm plastic containers were used as planting material.

Installation of irrigation System: Test plants were irrigated using a drip system comprising of a sixteen-station timer, polyethylene pipes and one emitter per plant that discharged 0.5 gallons of water per hr. Each time the plants were watered uniformly until the soil moisture reached the field capacity. The amount of water applied to each plant varied to suit the prevailing climatic conditions (Fig. 1).

Planting: Planting holes of appropriate sizes (*i.e.*, 60 x 60 x 60 cm for shrubs and 30 x 30 x 30 cm for ground covers) were prepared as per the planting plan. After placing shrubs and groundcover plants in these holes, they were backfilled with a 1:1 (v/v) mixture of soil and sphagnum peat moss, and pressed lightly to provide adequate anchorage for the plants.

Mulching treatments: Two types of organic mulch (processed pine bark and compost) procured locally were used in the study. Three to 4 cm deep layer of the mulch was applied uniformly to the surface of the soil after planting.

Irrigation: The irrigation requirement was calculated using the evapotranspiration rate of 15 mm/day (Taha *et al.*, 1988) for July to September and then half the amount from October 2002 until May 2003. All mulch treatments received the same amount of irrigation water daily.

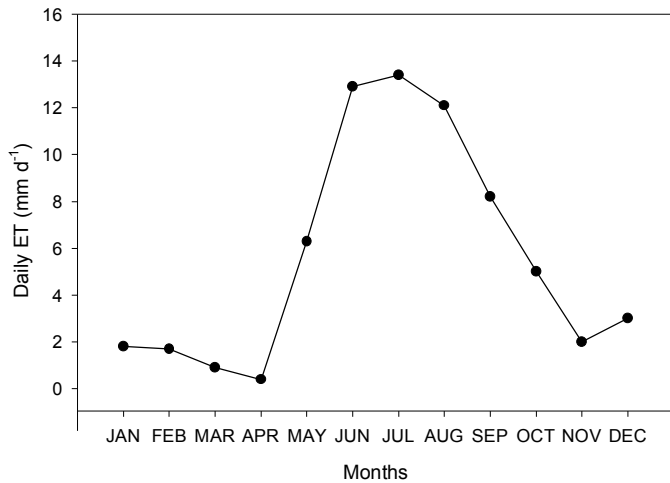


Fig. 1. Daily evapotranspiration rates used for determining the irrigation requirements of experimental plants

Results and discussion

The effects of the two mulches on growth of four plant species were assessed in terms of periodic seedling survival, average height growth and seedling canopy. The initial seedling establishment was 100% in all the species. CM seedlings recorded the 92.85% survival in bark, 71.43% in compost mulch treatments and the control recorded 84.52% survival. A few RO in the compost treatment died during the later stages of development. Otherwise, the rest of the seedlings survived until the end of the experiment.

Plant species grew at different rates under using different mulch treatments (Fig. 2). In ten months, height increments in VA was 96.47, 95.26 and 67.03% using horticultural bark, compost and no mulch, respectively. Similarly, in CM, height increments were 392.92, 359.69 and 434.23%. In MP, height increments recorded 220, 274.22 and 195.02% and RO recorded 195.17, 215 and 193.63 % by using horticultural bark, compost and no mulch, respectively.

VA performed best when bark was used as a surface mulch, whereas, CM performed better without using mulch. In MP and RO, seedling height was improved by using compost as surface mulch.

Seedling canopy increased due to the application of bark in VA and CM (Fig. 3), whereas MP and RO benefited more from the compost mulch. The increase in plant canopy was the lowest in the control treatments in all the species.

The soil moisture fluctuated between 2.56 and 9.04 % and was not influenced by either species or irrigation (Fig. 4). However, soil moisture status was not different in the treatments. The

experimental site was near the sea and the water table was shallow (less than 1 meter during high tide). Thus, the soil moisture status might have been influenced by the fluctuating water table. Secondly, the soil texture in the experimental area was mostly sandy (sand above 90%). Because of high leaching rates, soil moisture differences were not significant. Hence, the use of surface mulch promoted growth by creating a better microclimate in the root zone (lower temperature, maintaining normal root activity, allowing recovery from day-time stress conditions and higher nutrient absorption).

VA yielded the highest biomass in bark treatment, whereas CM, MP and RO yielded the highest biomass by using compost as surface mulch (Table 1). There was hardly any difference in yield in CM by using either mulch type. The yield was least in the control treatments in all the plant species.

Major benefits of soil mulching have been documented by several reserachers (Billeaud. and Zajicek, 1989, Hild and Morgan,1993, Lloyd, *et al.*, 2002, Wilen, *et al.*, 1999). Soil moisture conservation by reducing evaporation from the soil surface and reducing weed that can use as much or more water than ornamental plants. Moreover, mulch also holds water near the place it falls so that more of it enters the soil. Mulch usually breaks the impact of irrigation water, thus slowing water movement and keeps water in contact with the soil. Leaching and decomposition of organic mulch increases soil fertility. Also,

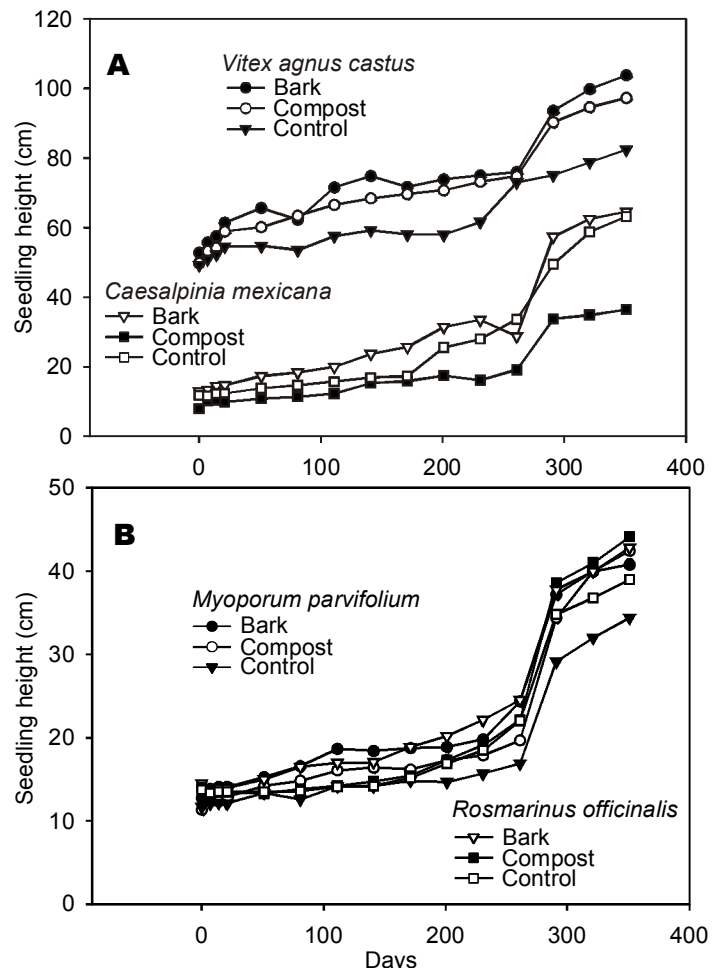


Fig. 2. Seedling height of different species under different mulch treatments. (A) *Vitex agnus castus* and *Caesalpinia mexicana* (B) *Myoporum parvifolium* and *Rosmarinus officinalis*

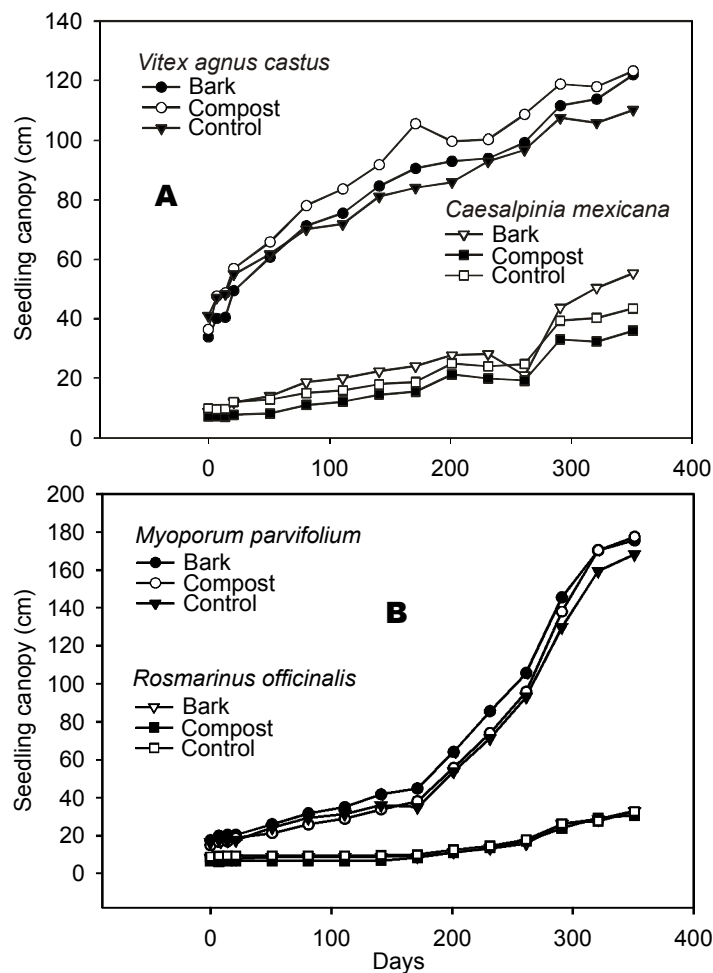


Fig. 3. Seedling canopy of different species under different mulch treatments. (A) *Vitex agnus castus* and *Caesalpinia mexicana* (B) *Myoporum parvifolium* and *Rosmarinus officinalis*

micro-organisms activity increases in mulch-covered soil.

Mulch reduces salt build up in the root zone by reducing evapotranspiration rates under arid conditions. Mulches moderate soil temperatures making it cooler in summer and warmer in winter. Reports are available which demonstrate that the use of mulches such as tree bark, jute material greatly improved the plant performance and eliminated weed growth under the crop canopy (Sawant and Dayanand, 1994; Wofford and Orzolek, 1993). These materials have good promise in arid climates.

The study was conducted for assessing the effects of organic mulches on vegetative growth of four proven potential introduced ornamental plants. Results indicated significant benefits of application of processed bark as surface mulch in increasing plant height and canopy in VA. However, CM was not affected in height while using mulch and the canopy increased by using bark as mulch. MP and RO plants with compost mulch had higher seedling growth and larger canopy than those in the processed bark. The root zone soil moisture regimes were similar in all treatments

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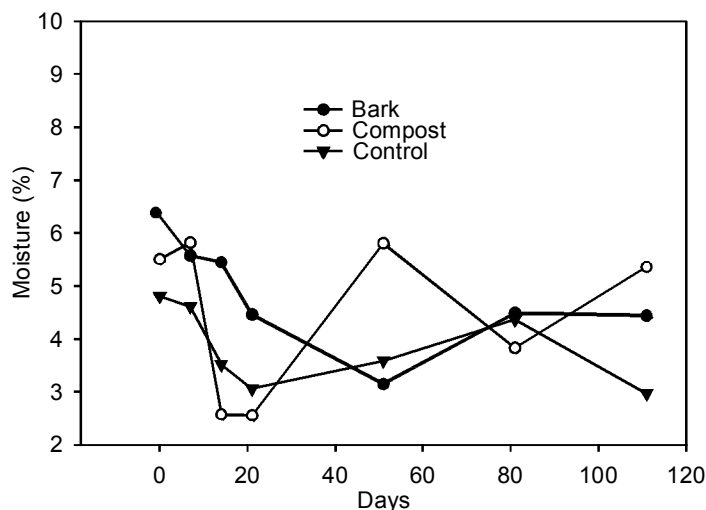


Fig. 4. Soil moisture fluctuation under different treatments

Table 1. Plant biomass in different species under different mulch treatments

Species	Mulch type	Fresh weight (g)	Dry weight(g)
Shrubs			
<i>Vitex agnus castus</i>	Bark	173.55	88.85
	Compost	165.15	76.25
	Control	127.50	67.40
<i>Caesalpinia mexicana</i>	Bark	52.50	32.65
	Compost	42.25	33.25
	Control	59.80	24.95
Groundcovers			
<i>Myoporum parvifolium</i>	Bark	228.65	80.00
	Compost	247.15	90.60
	Control	173.85	79.75
<i>Rosmarinus officinalis</i>	Bark	49.85	33.40
	Compost	53.60	36.40
	Control	48.80	34.55

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