WATER USE EFFICIENCY OF *POPULUS EURAMERICANA*

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Abstract

Spring planted popular plants produced an average 30.5 g biomass as Compared to 11.5 g biomass produced by late summer planted plants. The water use efficiency of spring sown popular plants was 358 g and 333 g in mulched and unmulched pots respectively while for late summer sown plant it was 381 g and 342 g respectively in mulched and unmulched pots. This indicated that seasonal differences have little effect on water use efficiency of popular plants. However, mulched plants were less efficient user of water than unmulched plants both in the spring and late summer season. The relative amount of water evaporated by mulched and unmulched pot soil was approximatly 50 and 70 percent less respectively over the free water surface.

Introduction

On account of scarcity of natural fuel resources in Pakistan, it is the urgent need of the day to grow quickly as much wood as possible. As a matter of fact the demand for wood and wood products, especially of small sized round timber is extra ordinarily increasing. The genus Populus hold a very special place among fast growing spacies by virtue of its suitability for cultivation both inside and out-side the forests and for the extensive range of products which it yields. Very little is known about the water use efficiency of popular in Pakistan. Since water is a limiting factor in the production of trees in Pakistan, therefore water utilization by popular is of special significance for us. The objective of present study was to determine (i) the water use efficiency by hybrid (*Popular euramericana*) and (ii) the effect of seasonal variations on water use efficiency.

Materials and Methods

Eighteen containers of 12 kg. soil capacity and 25 cm diameter were taken and used according to the method described by BRAUN (1973). Sixteen of them were provided with a drain at the bottom while the remaining two were kept as such. In these sixteen containers one inch thick layer of crushed stones and one inch thick layer of sand was spread at the bottom to facilitate the water to drain out. The remaining portion of each container was then filled with a mixture of 95 percent clayey loam field soil and 5 percent farm yard manure. Out of sixteen soil containing pots 12 pots were planted on 15.3.84 each with a shoot cutting (30 cm

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long and 1.0 to 1.25 cm thick) of *Populus euramericana* after weighing them individually. The first 6 randomly selected planted pots were provided with rice husk mulch to check the evaporation and to estimate the consumption transpired, while the other 6 planted pots remained without mulch to determine the evapotranspiration. Equal number of cuttings of similar size and length were weighed green as well as oven dry to determine their moisture content. Of the remaining four soil containing pots two were mulched with rice husk while the two were left unmulched. They were kept as such and were not planted. After planting cuttings in 12 containers the above sixteen containers were provided first watering and from then onward they were weighed before and after each consective watering. The experiment continued for 14 weeks upto 28.6.83. The remaining two containers were filled with water alone and weighed before and after each watering to determine the rate of evaporation from water surface. The same experiment was repeated during the late summer with planting of seedings from 16.7.84 to 31.10.84 to see the effect of seasonal variation on water use efficiency. In this case plastic containers of 22 kg. soil capacity and 30 cm diameter were used and instead of popular shoot cuttings 12 entire plants of 90 to 150 cm height with ball of earth were planted with treatments as described above.

The plants in each set of experiment were oven dried after harvesting and weighed. The difference of the final and the initial dry weight of plants was biomass produced during the 14 weeks duration of the experiment. The quantity of water used for producing this dry weight of the wood was computed from the data of weights recorded regularly before and after each watering during the experiment. The water consumption was then calculated by the following formula.

$$\text{Water Consumption} = \frac{\textit{Total water consumed (grams)}}{\text{Total weight of biomass (oven dried) produced (grams).}}$$

Results and Discussion

The spring sown popular plants yielded an average of 29 and 32 gram of biomas when grown in pot soil, mulched and unmulched respectively, for 14 weeks (Table–1). Similarly late summer sown popular plants yielded an average of 11 and 12 gram of biomass when sown in mulched and unmulched pots for the same duration. Thus spring sown popular plants on an average produced (29+32)/2=30.5 g biomass as compared to (11.12)/2=11.5 g biomass produced by plants grown during the late summer period. In other words, spring plants produced 165.2 percent more biomass as compared to late summer plants. The reason for reduced biomass production by late summer plants was the severe planting shock in mid July and low temperature during late September and October.

The water use efficiency (i.e. water consumed for one gram of biomass produced) of spring sown popular plants was 358 g and 333 g in mulched and unmulched pots respectively while for late summer sown plant it was 381 g and 342 g respectively in mulched and unmulched pots. This gave an average of (385+333)/2=345.2 g water use efficiency for spring

plants as compared to (381+342/2=351.2 g for late summer plants, which approximatly equal to each other. This clearly indicated that seasonal differences have no effect on the water use efficiency of popular plants. However, the data revealed that in both the spring and late summer seasons the mulched plants were less efficient user of water (358+381)/2=369.5) than unmulched plants (333+342)/2=337.5). This is possibly due to availability of relatively liberal amounts of water to the mulched plants leading to a little extra root absorption than the unmulched plants. An increases soil moisture contents resulting into less efficient utilization of water have been reported (Diamitrov, 1978). The over all estimate of water utilization by popular plants is (358+333) + (381+342/4=371 g) of water for one gram biomass production under Faisalabad conditions. This compares favourably with other reports (Baker, 1950; Greulach, 1973 and Dimarov, 1978).

The relative amount of water evaporated from pots having free water surface, or wet unmulched on mulched soil surface varied greatly (Table-2). The wet unmulched soil evaporated 45.27 percent and 54.5 percent less water over free water surface during spring and late summer respectively while wet mulched soil surface evaporated 72.52 and 74.0 percent less water over free water surface during spring and late summer. Similarly pots having mulched soil evaporated 49.88 and 46.9 percent less water over unmulched wet pots in spring and late summer. Thus it is evident that seasonal variation have little effect on percent water evaporation from wet mulched and unmulched soils in pots.

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TABLE 1

THE AVERAGE AMOUNT OF WATER ADDED, EVAPOTRANSPIRED, CONSUMED BY P. EURAMERICANA AND THE QUANTITY OF BIOMASS PRODUCED FOR WATER CONSUMED DURING 14 WEEKS OF GROWTH

Treatment	Weight of water added	Weight of rainfall water	Total weight of water added	Water drained not utilized	Net weight of water added	Weight of water evaporated from soil	Net weight consumed	Total biomass produced	Water use efficiency i.e. water consumed for/gram biomass produeced
FIRST EXPERIMENT:			(conducted during spring i.e. 15-3-84 to 28-6-84)						
– Pot having evaporation from free water surface and no plant.	68223	4789	73012	7527	65485	65485	–	–	–
– Pots having evaporation from soil surface and no plants.	73642	4789	42481	6650	35842	35842	–	–	–
– Pots having evaporation from mulched soil and no plants.	3469	4789	39484	21480	18000	18000	–	–	–
– Pots with plants and mulched soil.	30492	4789	35281	6819	28380	18000	10380	29	358
– Pots with plant and unmulched soil.	45065	4789	49854	3354	46168	35842	10647	32	333

SECOND EXPERIMENT: (conducted during late summer i.e. 16-7-84 to 31-10-84)									
– Pots having evaporation from free water surface and no plant.	32042	18137	49978	32249	16930	16930	–	–	–
– Pots having evaporation from soil surface and no plant.	6750	18137	24887	17021	7866	7866	–	–	–
– Pots having evaporation from mulched soil and no plant.	6500	18137	24637	20459	4176	4018	–	–	–
– Pots with plants and mulched soil.	8167	18137	26304	18090	8214	4118	4196	11	381.3
– Pots with plant and unmulched soil.	8867	18137	2604	15034	11969	7866	4104	12	342.0

* The figures in the first three treatments are the averages of two pots while in 4th and 5th treatments are averages of Six pots each with single seedling of *P. euramericana*.

TABLE 2

RELATIVE AMOUNT OF WATER EVAPORATED BY POTS HAVING FREE WATER SURFACE OF WET SOIL SURFACE (UNMULCHED AND MULCHED) DURING 14 WEEKS DURATION OF SPRING AND LATE SUMMER'

	Treatments	Amount of water evaporated (g)	Percent decrease in evaporation over free water surface	Percent decrease in evaporation over unmulched wet soil surface
(I)	DURING SPRING:			
	Pots having evaporation free water surface.	65485	–	–
	Pots having evaporation from wet soil surface	35842	45.27	–
	Pots having evaporation from mulched soil surface.	18000	72.52	49.88
(II)	DURING LATE SUMMER:			
	Pots having evaporation from free water surface.	16930	–	–
	Pots having evaporation from wet soil surface (mulched).	7866	53.5	–
	Pots having evaporation from mulched wet soil surface.	4176	74.0	46.9