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Comparison of wheatgrass (*A. intermedium*) and tall wheatgrass (*A. elongatum*) in transpiration viewpoint

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ABSTRACT
Transpiration, as one of the components of hydrological cycle, has not been paid enough attention yet, while it is necessary for sound utilization of rangelands, mostly located in the arid and semiarid regions. The comparison of the different kinds of rangelands species in terms of transpiration rates provides range managers the required information to achieve optimal forage production for a given input precipitation. The present study is a preliminary comparison in transpiration between two important Iranian rangeland species viz. *A. intermedium* and *A. elongatum*. The amounts of daily evapotranspiration from aforesaid species of which 4–5 shoots were initially planted in small polyethylene pots with surface area of 50.27 cm^2 in five replicates were measured using weighing technique for a period of 33 days under relatively natural conditions. The amounts of daily transpiration of *A. intermedium* and *A. elongatum* were respectively varied from 1.4 to 9.4 and 1.5 to 9.1 milliliter. The results of the statistical analyses showed that there is no a significant difference between the amounts of transpiration for the two species on dry matter basis and therefore, the species may have the same value in rangeland improvement from transpiration point of view.

Key Words: Transpiration, *A. elongatum*, *A. intermedium*, Hydrologic Cycle, Range Management, Iran

INTRODUCTION
The water, soil and plant relationships still have not been defined fully and therefore more regular and consistent studies are required. Eco-hydrology which concerns with interactions between the hydrological processes and the plant effects is strictly suggested to be appropriately considered. Preservation of soil and water as well as water use of vegetation cover is of great important in rangelands which cover some 40% of terrestrial part of the world out of which about 80% have dry and semi-dry climates (Gamougoun *et al.*, 1984). Some particular aspects of hydrologic cycle such as transpiration and interception are much more neglected owing to difficulties in field measurements. Quantifying the components of water balance for a watershed is crucial toward understanding of the dominant hydrologic processes occurring in a basin (Flerchinger and Cooley, 2000). Many of the keycontrols on water use by vegetationinvolve the water uptake by roots, the transfer of liquid water through plants and the control of vapor loss from the leaf surfaces by the opening and closure of the stomata (Roberts, 2000), simply called as transpiration. The comparison of different kinds of rangelands species in terms of transpiration rates therefore provides good prerequisites for a successful range management. Many studies have been undertaken for measurement of transpiration occurred by forest species (Calder, 1978; Kaufmann, 1985; Roberts and Rosier, 1993 and Ryan, 2000), but very limited studies have been conducted for the measurement of transpiration rate for rangeland species. In this regard, most of the studies have emphasized on transpiration estimation through determination of other hydrologic components in water balance model whose accuracy is therefore controlled by the efficacy consumed for the measurement of other components. Kirnak *et al.* (2001) in Turkey have monitored the transpiration rate from *Solanum melogenea* planted in small polyethylene vases during different times in a day for a period of 16 weeks. They reported that the maximum and the minimum rate of transpiration occurred in 2

PM, and 6 AM and 8 PM, respectively. Obrist *et al.* (2003) also studied the transpiration occurred by *Bromus tecturum* in Las Vegas. They resulted that the transpiration rate is controlled by indices of leaf area and root length density. In the study conducted by Sadeghi and Rahimzadeh Halagh (2005) in Iran, the average amount of daily transpiration of 4 to 5 shoots of *Bromus inermis* and *Vicia villocea* planted in small vases during 1.5 months experimental period was respectively found 5.17 and 5.36 mm. The difference in transpiration quantity between the two study plants was not statistically significant. The minimum and maximum amounts of transpiration for *Bromus inermis* varied from almost zero to 10.06 milliliter; whereas the corresponding values for *Vicia villocea* was reported 1.11 and 9.94 mm, respectively. Another research was taken place by Sadeghi and Rahimzadeh Halagh (2006) in Iran on transpiration of *Festuca ovina* and *A. intermedium*. The amount of average daily transpiration of *Festuca ovina* and *A. intermedium* was respectively found to be equal to 5.11 and 5.03 milliliter. The results of the statistical analysis showed that there is significant difference between the amounts of transpiration per shoot and dry matter between the two plants at the 99% significance level. From reviewing of the literature, it is understood that the researches in field of transpiration as well as many other eco-hydrologic subjects still is at the preliminary stages and more studies are then required in this field. The present study therefore attempts to get some ideas about the amount as well as the probable difference in water consumption through transpiration by two other important Iranian rangeland species viz. *A. intermedium* and *A. elongatum* to draw some important base lines for the betterment of rangeland reclamation and development from hydrologic point of views.

MATERIALS AND METHODS

To conduct the study, 4–5 shoots of *A. intermedium* and *A. elongatum* species were sowed in small polyethylene pots with surface area of 50.27 cm^2 in five replicates. Another 5 pots were also filled up with the same sandy loam soil and kept empty in order to measure the amount of evaporation taken place from the bare soil.

The study was prolonged from 29 May to 30 June 2004 for a period of 33 days under relatively natural conditions. The study got stopped once some of the plants were thoroughly wilted. The conditions have been adjusted in such a way to allow plants to receive direct sunlight and not to be affected by natural rainfall. All measurements were made at 2 PM, when the maximum transpiration rate was expected (Kirnak *et al.*, 2001). The amounts of daily evapotranspiration of aforesaid species as well as evaporation from bare soil surfaces were measured using gravimetric method. This method has been noted as the simplest and the most applicable technique through determining the weigh lost during a day (Kirnak *et al.*, 2001) with the help of scale having 0.0001gr accuracy. A view of the site of experiment is shown in Fig. 1.

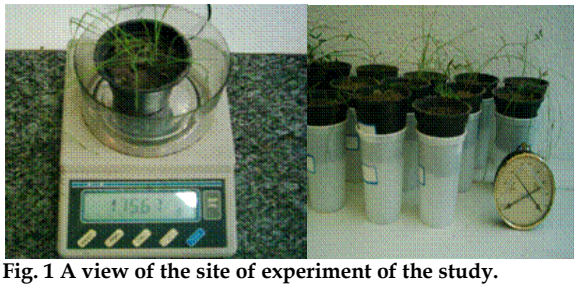

Fig. 1 A view of the site of experiment of the study.

The amount of transpiration was then calculated through subtracting the evaporation from the evapotranspiration values obtained respectively from the un-planted and the planted vases. The amounts of water lost from or added to the vases respectively during any probable drainage or through irrigation were also accurately measured and were considered in calculations.

The transpiration values occurred by both of the species were determined on vase, shoot and dry matter bases, and its variations was ultimately studied to evaluate water consumption rate and plant efficiency. The statistical comparison was conducted with the help of paired t-test application in STATISTICA software package.

RESULTE AND DISCUSSION

The amounts of average daily transpiration of *A. intermedium* and *A. elongatum* measured as per the procedure explained above are shown in Fig. 2. Some statistics of the transpiration measured data as well as experimental condition are summarized in Table 1.

According to the data collected for a climatological station near to the study site, the average long term rate of annual evapotranspiration is some 700 mm. The potential evapotranspiration rates for months May and June are also about 90 and 95 mm,

respectively (Mazandaran Province Fishery Organization, 2004).

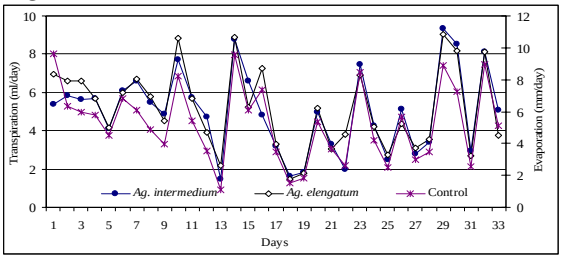

Fig. 2 Daily transpiration rate of studied species during the study period along with evaporation

As it is seen in Fig. 2, the transpiration rates have got changes during the study period but the trend in both of the species was similar. The daily changes in transpiration rates may be because of changing air humidity and temperature as noted by Roberts (2000). Table 1 also shows that the statistics summary of the transpiration rates measured for the two species are similar while the number of shoots and amount of dry matter is slightly higher in case of *A. elongatum* than those belonging to *A. intermedium*. The average values of transpiration measured during the study is almost similar to those reported by Sadeghi and Rahimzadeh Halagh (2005 and 2006).

The results of ANOVA and t-test analyses also show that there is no a significant difference between the amount of transpiration among the replicates of the planted species as well as amounts of transpiration between the two species at 5% significance level. The statistical comparison of transpiration taken place by the species was also conducted using the paired t-test with respect to numbers of shoots (milliliter per shoot) and dry matter (milliliter per gram of dry matter). The results of analysis verified the significant difference between the two species with respect to the amount of transpirating per shoot at 1% level of significance. Theresults of paired t-test conducted between transpiration values of the species per dry matter are summarized in Table 2. However, the difference between transpiration on dry matter basis was not statistically ascertained though it was found that transpiration rate was higher in *A. intermedium*. The water consumption of *A. elongatum* and *A. intermedium* was found at tune of 53.20 and 59.17 milliliter per day per gram of dry matter, respectively.It may be because of differences between the aerial parts of the plants as reported by Kaufmann (1985). The possible difference in physiological behaviors of the species may also be assumed as another reason behind the disagreement of transpiration rates as mentioned by Anderson (1981), and Roberts and Rosier (1993).

CONCLUSION

The results of this study demonstrated that the daily rate of water consumption by wheatgrass (*A. intermedium*) and tall wheatgrass (*A. elongatum*) is not significantly different. This result has a great importance for ranchers in range improvement from hydrologic point of view through selecting of suitable and pertinent species acclimated to the same climatological and physical conditions. Further studies on other species as well as conducting the same experiments for a longer period considering entire phonological stages are ultimately recommended.

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Table 1. Descriptive statistical values of measured transpiration data.

Species \ Variable	Average (ml/day)	St. Deviation (ml/day)	Min. (ml/day)	Max. (ml/day)	Ave. No. of shoots	Dry matter (gr)
A. intermedium	5.029±0.760	2.144	1.447	9.353	2.4	0.085
A. elongatum	5.160±0.760	2.147	1.486	9.052	3.1	0.097

Table 2. Results of paired t-test for transpiration values of studied species per dry matter.

Species \ Variable	Average (ml/day)	St. Deviation (ml/day)	No. of data	t-value	Degree of freedom	P-value
A. intermedium	5.029±0.760	2.144				
A. elongatum	5.160±0.760	2.147	33	-0.938674	32	0.354930

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