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# Modeling Ecological Responses of Some Forage Legumes in Iran

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***Abstract*—**Grasslands of Iran are encountered with a vast desertification and destruction. Some legumes are plants of forage importance with high palatability. Studied legumes in this project are *Onobrychis*, *Medicago sativa* (alfalfa) and *Trifolium repens*. Seeds were cultivated in research field of Kaboutarabad (33 km East of Isfahan, Iran) with an average 80 mm. annual rainfall. Plants were cultivated in a split plot design with 3 replicate and two water treatments (weekly irrigation, and under stress with same amount per 15 days interval). Water entrance to each plots were measured by Partial flow. This project lasted 20 weeks. Destructive samplings ($1m^2$ each time) were done weekly. At each sampling plants were gathered and weighed separately for each vegetative parts. An Area Meter (Vista) was used to measure root surface and leaf area. Total shoot and root fresh and dry weight, leaf area index and soil coverage were evaluated too. Dry weight was achieved in $75^0$c oven after 24 hours. Statgraphic and Harvard Graphic software were used to formulate and demonstrate the parameters curves due to time. Our results show that *Trifolium repens* has affected 60 % and *Medicago* sativa 18% by water stress. *Onobrychis* total fresh weight was reduced 45%. Dry weight or Biomass in alfalfa is not so affected by water shortage. This means that in alfalfa fields we can decrease the irrigation amount and have some how same amount of Biomass. *Onobrychis* show a drastic decrease in Biomass. The increases in total dry matter due to time in studied plants are formulated. For *Trifolium repens* if removal or cattle entrance to meadows do not occurred at perfect time, it will decrease the palatability and water content of the shoots. Water stress in a short period could develop the root system in *Trifolium repens*, but if it last more than this other ecological and soil factors will affect the growth of this plant. Low level of soil water is not so important for studied legume forges. But water shortage affect palatability and water content of aerial parts. Leaf area due to time in studied legumes is formulated. In fact leaf area is decreased by shortage in available water. Higher leaf area means higher forage and biomass production. *Medicago* and *Onobrychis* reach to the maximum leaf area sooner than *Trifolium* and are able to produce an optimum soil cover and inhibit the transpiration of soil water of meadows. Correlation of root surface to Total biomass in studied plants is formulated. *Medicago* under water stress show a 40% decrease in crown cover while at optimum condition this amount reach to 100%. In order to produce forage in areas without soil erosion *Medicago* is the best choice even with a shortage in water resources. It is tried to represent the growth simulation of three famous Forage Legumes. By growth simulation farmers and range managers could better decide to choose best plant adapted to water availability without designing different time and labor consuming field experiments.

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***Keywords*—**Ecological parameters, *Medicago*, *Onobrychis*, *Trifolium*.

## I. Introduction

GRASSLANDS of Iran are encountered with a vast desertification and destruction. Some legumes are plants of forage importance with high palatability. Studied legumes in this project are *Onobrychis*, *Medicago sativa* (alfalfa) and *Trifolium repens*. In many parts of the world forage production is limited by drought during the growing season. While these stresses are essentially capable of causing plant death, it is most commonly their interaction with defoliation stress that leads to a decline in grassland productivity. In intensive livestock systems, the desire to maximize forage production and utilization, coupled with economic pressures, may result in management strategies that enhance rather than minimize the effect of these stresses. Heat and frost and other environmental stress have been studied on different grass and forage legumes [1]-[3].

There is always a need to optimize yield and forage quality especially in arid lands like Iran. Understanding how forage plants tolerate stresses like water shortage and dry periods can be useful in designing management strategies that meet the yield and forage quality goals of individual producers. A key factor that determines stress tolerance of forages, and whether they will persist is the level of water stored in roots and shoots [4].

Droughts are an inevitable and recurring feature of nowadays agriculture, however, relatively few drought studies or simulations have been conducted in Iran. Despite attempts to predict droughts, and reduce their impact, they are still the single most important factor affecting world food security [5]. When soil moisture and rainfall are inadequate during the growing season, it is difficult to support healthy top growth to maturity and to prevent extreme crop stress and wilt.

The effects of drought tend to accumulate gradually and may persist for long periods of time, making it difficult to determine when a drought actually starts and finishes. The severity of drought is also difficult to define, and will be influenced by human disturbance in natural environment and the type of vegetation. Droughts differ from one another in intensity, duration, and spatial coverage [6].

Forage crops frequently face the additional stress of defoliation during periods of water shortage, and while many forage species can survive either of these stresses alone, the combined effects frequently lead to plant death. Where plants

are physiologically well adapted to survive the conditions of water shortage, it is often decisions related to stocking density and defoliation frequency that determine the persistence and subsequent vigor of the sward [7].

For drought the inherent variability, and inability to predict the severity or longevity of the stress period, presents the major challenge to both plant and managers. Water stress decrease plant growth rates via stomata closure, leaf rolling, lower rates of photosynthesis and reduced leaf area. The three ways through which plants can tolerate drought are: drought escape, drought avoidance and drought tolerance [8].

## II. Methods and Materials

Seeds were cultivated in research field of Kaboutarabad (33 km East of Isfahan, Iran) with an average 80 mm. annual rainfall (Fig. 1). Plants were cultivated in a split plot design with 3 replicate and two water treatments (weekly irrigation, and under stress with same amount per 15 days interval). Water entrance to each plots were measured by Partial flow. This project lasted 20 weeks. Destructive samplings ($1m^2$ each time) were done weekly. At each sampling plants were gathered and weighed separately for each vegetative parts. An Area Meter (Vista) was used to measure root surface and leaf area (Fig. 2). Total shoot and root fresh and dry weight, leaf area index and soil coverage were evaluated too. Dry weight was achieved in $75^0$c oven after 24 hours. Statgraphic and Harvard Graphic software were used to formulate and demonstrate the parameters curves due to time.

## III. Results & Discussion

Our results show that *Trifolium repens* has affected 60 % and *Medicago* sativa 18% by water stress. *Onobrychis* total fresh weight was reduced 45%. Dry weight or Biomass in alfalfa is not so affected by water shortage. This means that in alfalfa fields we can decrease the irrigation amount and have some how same amount of Biomass. *Onobrychis* show a drastic decrease in Biomass. The increases in total dry matter due to time in studied plants are formulated. For *Trifolium repens* if removal or cattle entrance to meadows do not occurred at perfect time, it will decrease the palatability and water content of the shoots. Water stress in a short period could develop the root system in Trifolium repens, but if it last more than this, other ecological and soil factors will affect the growth of this plant. Low level of soil water is not so important for studied legume forges. But water shortage affect palatability and water content of aerial parts. Leaf area due to time in studied legumes is formulated. In fact leaf area is decreased by shortage in available water. Higher leaf area means higher forage and biomass production. *Medicago* and *Onobrychis* reach to the maximum leaf area sooner than *Trifolium* and are able to produce an optimum soil cover and inhibit the transpiration of soil water of meadows. Correlation of root surface to Total biomass in studied plants is

Fig. 1 Cultivation in research field of Kaboutarabad

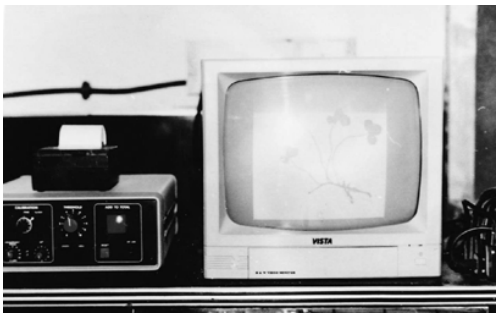

Fig. 2 Leaf area Meter used in this study

formulated. *Medicago* under water stress show a 40% decrease in crown cover while at optimum condition this amount reach to 100%. In order to produce forage in areas without soil erosion *Medicago* is the best choice even with a shortage in water resources.

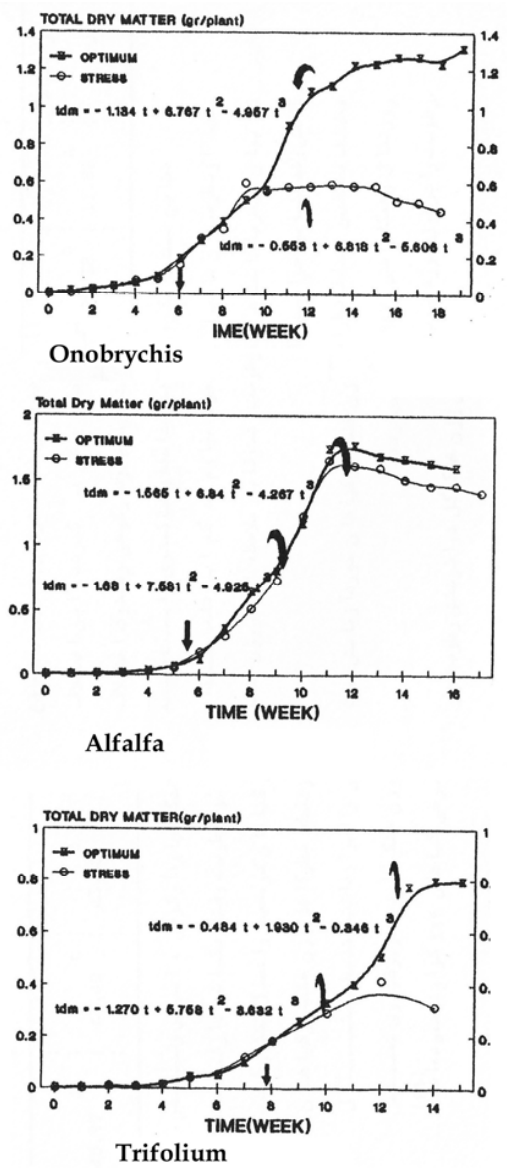


Fig. 3 Total dry matter simulation based on time (t) between optimum and stressed conditions for three studied legumes in this study

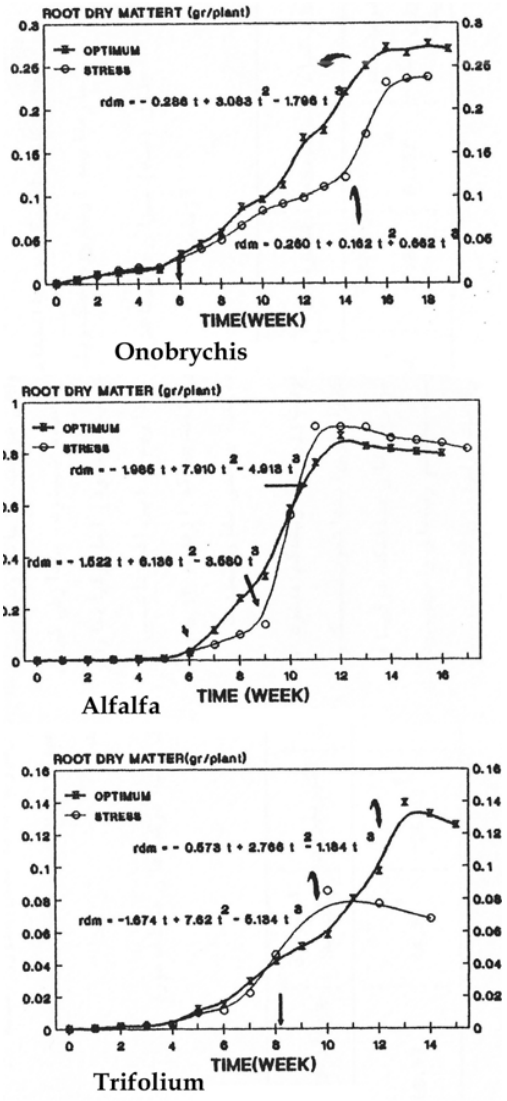


Fig. 4 Root dry matter simulation based on time (t) between optimum and stressed conditions for three studied legumes in this study

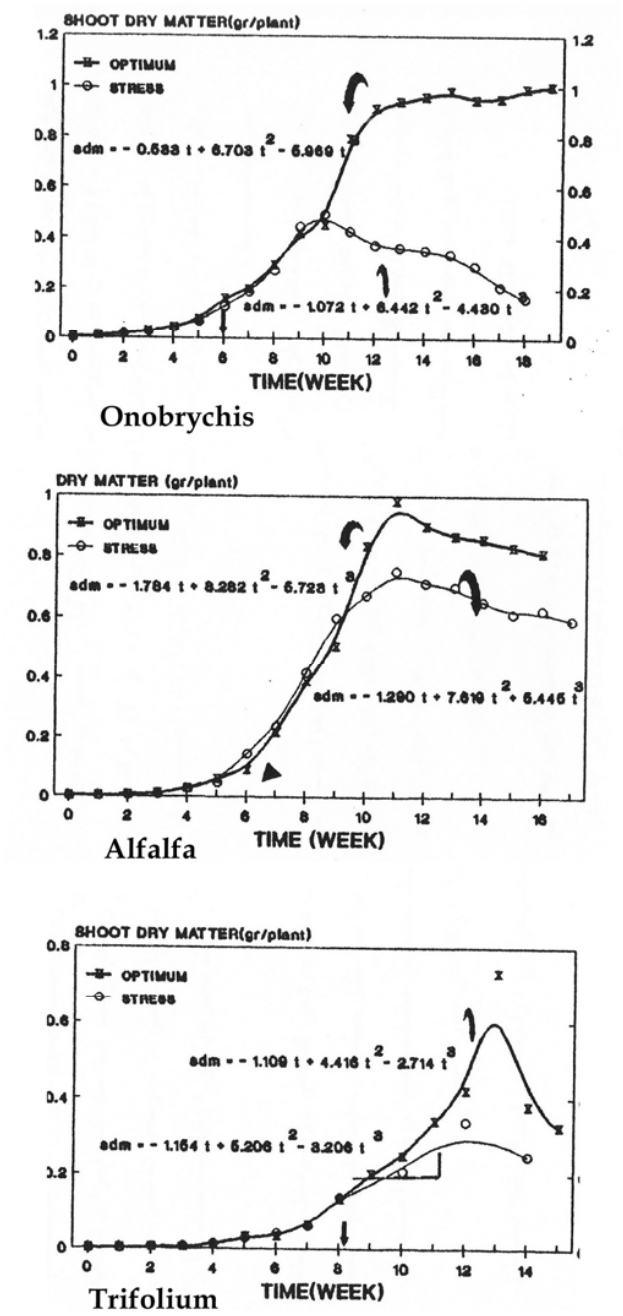


Fig. 5 Shoot dry matter simulation based on time (t) between optimum and stressed conditions for three studied legumes in this study

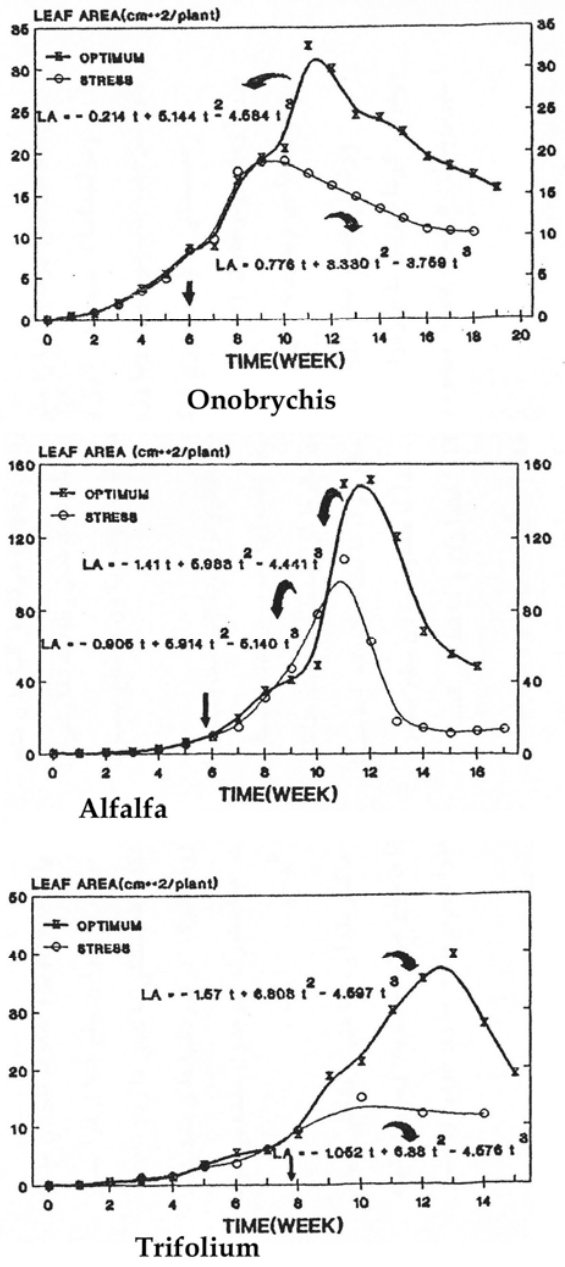


Fig. 6 Leaf area simulation based on time (t) between optimum and stressed conditions for three studied legumes in this study

## IV. Conclusion

This study tries to represent the growth simulation of three famous Forage Legumes in Iran. By growth simulation farmers and range managers could better decide to choose best plant adapted to water availability without designing different time and labor consuming field experiments.

## REFERENCES

[1] M. Badaruddin and D.W. Meyer, "Factors Modifying Frost Tolerance of Legume Species" Crop Sci. 41:1911–1916, 2001.
[2] R.P. Collins, M.J. Glendining and L. Rhodes, "The relationship between stolon characteristics, winter survival and annual yields in white clover (Trifolium repens L.)." Grass and Forage Science 46: 51-81, 1991.
[3] J.J. Mott, M.M. Ludlow, J.H. Richards and A.D. Parsons, " Effects of moisture supply in the dry season and subsequent defoliation on persistence of the savanna grasses Themeda triandra, Heteropogon contortus and Panicum maximum," Australian Journal of Agricultural Research 43: 241-260, 1992.
[4] J.R. King, S.P. Boschma, J.M. Scott and M.J. Hill, " Etiolated regrowth as a measure of potential forage grass recovery following drought stress in New South Wales, Australia, " Canadian Journal of Plant Science 76: 811, 1996.
[5] T.C. Hsiao, "Plant responses to water stress," Annual Review of Plant Physiology 24: 519-570, 1973.
[6] P.J. Kramer, "Drought stress, and the origin of adaptations" in Adaptation of Plants to Water and High Temperature Stress, N.C. Turner and P.J. Kramer, Eds. Wiley, New York. 1968, pp. 7-20.
[7] D.K.Singh, and P.W.G. Sale, "Growth and Potential Conductivity of White Clover Roots in Dry Soil with Increasing Phosphorus Supply and Defoliation Frequency," Agron. J. 92:868–874, 2000.
[8] R. Serraj, F.R. Bidinger, Y.S. Chauhan, N. Seetharama, S.N. Nigam, and N.P. Saxena,"Management of Drought in ICRISAT Cereal and Legume Mandate Crops," Water Productivity in Agriculture: Limits and Opportunities for Improvement, J.W. Kijne, R. Barker and D. Molden, Eds. 2003.

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Dr. Keshavarzi is an active member of some professional societies in Iran: Member of Iranian biologist society in 1995, a member of weed science society in 2002, a member of TWOWS in 2005. She had won some awards in Iranian research week from 2002 – 2010 at Alzahra University.