Caragana High-Quality Development

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Abstract: As economic develop and population increase, there is an increasing demand for plant goods and ecological service. Because plant goods and service producing by original forest cannot meet the increasing need of people, most of the original forest has gradually become fruit, farmland, plantation and grass. A lot of exotic plant was introduced to produce special production and service in the plant restoration. As introduced plant grow, vegetation decline and crop failure will happen because plant overload and overuse nature resources or plant waste resources because plant underuse nature resources because underload. To solve these problems, according to my years of research, the results have showed that there is a resource use limit by plants, vegetation carrying capacity and the critical period of plant resources relation regulation. Resources use limit by plants includes space resources use limit by plants in soil water and nutrient rich regions, soil water resources use limit by plants in water-limited regions and soil nutrient resources use limit by plants in nutrient-limited regions. vegetation carrying capacity includes space vegetation carrying capacity, soil water vegetation carrying capacity and soil nutrient vegetation carrying capacity and the critical period of plant resources relation regulation in the process of plant growth. When the available amount of nature resources reduced to resources use limit by plants, such as soil water resources use limit by plants, which is the soil water resources in the range of the maximum infiltration depth is equal to soil water resources use limit by plants, the plant resources relation enters the critical period of plant resources relation regulation. The ending time of the key period of plant resources relation regulation is the ineffective time of plant resources relation regulation. If the existing plant density is more than vegetation carrying capacity in the key period of plant resources relation regulation, the plant resources relation has to be regulated on the vegetation carrying capacity to get maximal yield and beneficial effect and realize sustainable use of nature resources, high quality sustainable management of forest vegetation and agriculture high quality production.

Keywords: Key period of plant resources relation regulation, Plant grow, Resources use limit by plants, Vegetation carrying capacity, High quality sustainable management of forest vegetation, Agriculture high quality production.

INTRODUCTION

Along with economic development and increase in population, there is an increasing demand for the quantity and variety of plant production and service, but the plant production, especially food, fruit, fibre and wood and son on produced by original forest ecosystem cannot meet the need of demand for the quantity and variety of timber, food, medicine and so on and ecological service, so 80% of the original forest in the loess plateau (Guo and Shao, 2013) and the world has become farmland, man-made forest and grass (Guo 2121a and b,) and a lot of exotic plant was introduced to produce more production and service. Because exotic plant changes the plant resources relation and the ability of self-regulation to adapt to climate change is very low, vegetation decline, crop failure, serious soil erosion, greenhouse gas emissions and other ecological and environmental problems happens (Chen & Shao, 2008). In order to solve the problem of soil degradation, vegetation decay or crop failure or waste of resources and achieve high-quality sustainable development and meet the increasing need of people for plant goods and service. Years of research has shown that there is a limit of plant utilization of soil water resources, the soil water vegetation carrying capacity and the key period of plant resources relation regulation and the method of high quality management of forest in water shortage area in the process of vegetation restoration (Guo *et al*, 1990; Guo,2021a and b). The main contents are as follows:

1. THE THEORY OF UTILIZATION LIMIT OF SOIL WATER RESOURCES

Along with plant growth, plant height , diameter and canopy volume increase, and roots develop deep and soil water resources in the root zone reduced but available soil water resources is declined. To obtain maximum yield and beneficial result and achieve high quality development, even the root distribution depth is more than the maximum infiltration depth, see Figure **2**, plant roots do not absorb water indefinitely due to lack of water such as in semiarid loess hilly region (Guyuan. China) where the precipitation changes with year and month, see Figure **1** (Guo & Shao, 2013; Guo 2019, 2021). There should be a control limit for the utilization of soil water resources by plants in water-scarce areas, that is, the soil water resources use limit by plants

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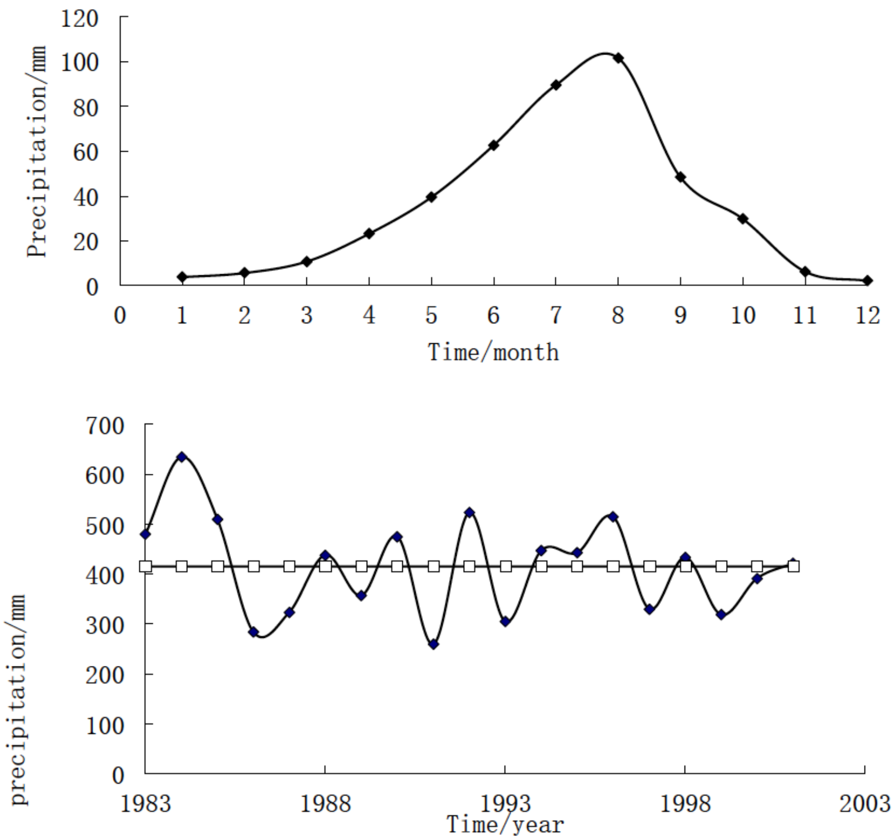

Figure 1: Change of precipitation with month (photo above) and year (photo below) in semiarid loess hilly region (Guyuan. China).

(Guo, 2010). It is the soil water storage (soil water resources) when the soil water content is equal to the wilting coefficient in the range of the maximum infiltration depth. The wilting coefficient expressed by the indicator plant, caragana because the wilting coefficient changes with plant species, The wilting coefficient at different soil depth in the maximum infiltration depth can be determined by centrifugal machine or press film. The undisturbed soil at different soil depth in a soil profile was taken by a cutting ring with a 5 cm high and 5cm diameter. The maximum infiltration depth can be estimated by the two curves method (Guo, 2014, 2020). The wilting coefficient is expressed by the wilting coefficient of indicating plants in a plant community. The indicator plants of natural vegetation are the constructive species, and the artificial vegetation is the target species. When the soil water resources decrease to the utilization limit of soil water resources, the plant-water relationship enters the starting time of critical period of plant-water relationship regulation (Guo & Li, 2009). At this time, the regulation of plant-water relationship should be considered to be regulated. The initial planting density influences the soil water resource use limit by plants (Guo *et al*, 2016).

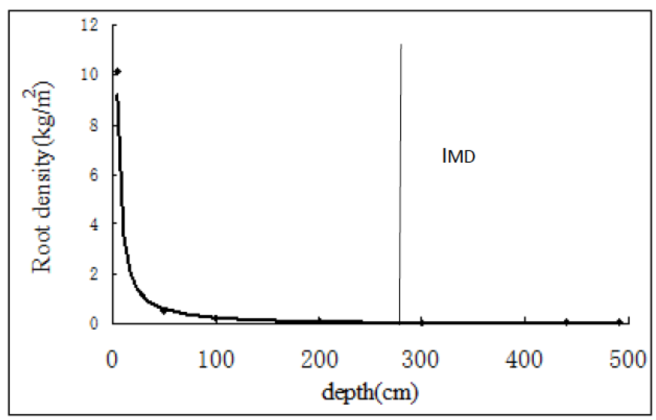

Figure 2: The caragana shrub root distribution depth and maximum infiltration depth (MID =290 cm) in semiarid loess hilly region(Guyuan, Ningxia China).

2. THEORY OF VEGETATION CARRYING CAPACITY

The ability of land resources to support vegetation is limit. The limit is vegetation carrying capacity. The ability of soil water resources to support vegetation is limited in water shortage area, which is called soil water carrying capacity for vegetation (Guo *et al*.

2002,). It refers to the maximum quantity per unit area of soil water resources that can maintain healthy growth of indicator plants at a given period and site condition (Guo & Shao, 2003; Guo 2014, 2021) and can be estimated by soil water-lant density model (Guo 2014, 2021), expressed by the number (absolute index) or density (relative index) of indicator plant population in the plant community. Soil water vegetation carrying capacity (SWVCC), changing with plant species (vegetation type), time or position, time climate change, especially the critical period of plant water relationship regulation, which is the theoretical basis for determining indicators and criteria for forest resources use degree and high quality and sustainable management of forest vegetation (Guo, 2014, 2021).

Figure 3: photo of Corn thin film cover and ridge tillage in semiarid loess hilly region on 21 May, 2021.

3. CRITICAL PERIOD OF PLANT- RESOURCES RELATIONSHIP REGULATION

Generally, along with plant growth, the available resources amount in a given canopy (cube) such as leaf amount in a given canopy or soil water resources in given soil depth, such as the maximum infiltration depth will also decrease, even though the soil water resources will increase after the rain. The plant water relationship enters the critical period of plant water relationship regulation. If the present plant density is more than soil water vegetation carrying capacity in the critical period of plant water relationship regulation, plant water relationship regulation has to be regulated. Plant-water relationship can be regulated Plant-water relationship can be regulated by different methods such as cultivating and selecting better plant species and varieties (Guo *et al*, 1990), soil preparation such as thin film cover and ridge tillage in the semiarid loess hilly region (Guyuan. China), see photo 3 and pruning some leave and trig and so on, but the most important method is to regulate the plant-water relationship by reducing plant density in the critical period of plant-water relationship regulation.

Plant- resources relationship in the growing season can be divided into different stages according to resources use limit by plants such as soil water resources use limit by plants in the water-limited regions. If the available resources in the canopy is more resources use limit by plants or soil water resources in the range of the maximum infiltration depth is more than soil water resources use limit by plants, showing resources such as soil water resources enough and plant grow healthily. If not, more attention should be paid to the plant-water relationship regulation.

The critical period of plant- resources relationship regulation refers to the time that the resources can maintain the plant growth healthy when the resources descend to the utilization limit of resources by plants such as soil water resources within the range of the maximum infiltration depth, it not only affects plant growth condition but also determines the maximum yield and benefit in the growing season in the water-limited regions. The critical period of plant water relationship regulation is the period from the starting time soil water resources reduced to the limit of soil water resources utilization by plants to the ending time plant water relationship regulation is failure. The ending time of critical period of plant water relationship regulation can be estimate by the thinning plant method. The ending time of the critical period of plant water relationship regulation is end of September because it is the end time of soil and water conservation forest and soil water loss mainly happened in the raining season. Sowing seeds in a plot with a maximum plant density and ensure the maximum experimental plant density equals to or more than soil water carrying capacity for vegetation.

4. HIGH QUALITY AND SUSTAINABLE MANAGEMENT OF CAGRAGANA SHRUB

Firstly, the better plant species and varieties must be selected according to site condition and cultivation goal or market need (Guo *et al*, 1990) and then suitable initially planting density must be taken. The initially planting density is request to be more than soil water vegetation carrying capacity such as soil water vegetation carrying capacity in water-limited regions. The suitable initially planting density for caragana shrub is 6500 shrub/100m^2 (seed amount is 1.5kg/100m^2) (Guo 2014). If the existing plant density is more than soil water carrying capacity for vegetation in the critical period of plant-water relationship regulation, showing plant overuse soil water and plant density exceeds soil water carrying capacity, which will cause soil degradation, vegetation decline, fruit and crop failure if plant-water relationship should not be regulated. At this movement, we should regulate the plant-water relationship by reducing the plant density. The reducing amount of plant density is equal to the different between the existing plant density and soil water carrying capacity for vegetation. When the soil water resources decrease to the utilization limit of soil water resources by plants in the range of maximum infiltration depth, plant-water relationship enters the critical period of plant-water relationship regulation. if the existing plant density is more than soil water carrying capacity for vegetation in the critical period of plant-water relationship regulation, plant-water relationship should be regulated by estimating the soil water carrying capacity for vegetation in the critical period of plant-water relationship regulation, and the maximum yield and benefit of forest can be obtained by determining and controlling the plant-water relationship according to the soil water vegetation carrying capacity in the critical period of plant-water relationship regulation. The high quality and sustainable development can be achieved in water-limited regions.

CONCLUSION

The most important work of forest restoration is the plant-resources relationship regulation in the process of vegetation, especially plant-resources relationship regulation in the critical period of plant- resources relationship regulation because it decides the maximum yield and benefit of a population or plant community. The foundation of plant-resources relationship regulation is resources use limit by plants, vegetation carrying capacity and the critical period of plant resources relation regulation. When resources amount reduced to utilization limit of resources by plants, such as the soil water resources within the range of the maximum infiltration depth descend to the utilization limit of soil water resources, plant- resources relationship enters the critical period of plant- resources relationship regulation in which the resources severe influence the plant growth and decides the maximum yield and ecological, economic and social benefits. At this time, the plant- resources relationship should be regulated to obtain the maximum yield and benefit to carry out sustainable use of soil water resources and high quality and sustainable development.

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CONFLICTS OF INTEREST

The author declared no conflicts of interest.

REFERENCES

[1] Budagovski A.I. (1986). Soil water resources and available water supply of the vegetation cover, Water Resources. 12(4): 317-325. http:// xueshu.baidu.com/ usercenter/paper/show?paperid=9b6e17d9e5931a0089968e 90a0192bef&site=xueshu_se

[2] Chen H, Shao M. Li Y. 2008. Soil desiccation in the Loess Plateau of China. Geoderma.143, 91-100. https://doi.org/10.1016/j.geoderma.2007.10.013

[3] Cohen J. E. 1995. Population growth and earth's human carrying capacity. Science. 269: 341-346.//www.docin.com/p-190920361.html. https://doi.org/10.1126/science.7618100

[4] Guo Z.S., Wu Q.X., and Si L.M.1990.A Study on selecting trees and grasses species of woodland for Fuel, Fodder and manure using fuzzy mathematics method in the loess hilly area. Journal of Biomathmatics.1990; 5(3): 69-76.

[5] Guo Z, Shao M, Zhang y, Wu Q. 2002. An Layer-dividing Approach to the soil water in forest land, the Proceedings of Soil Physics and Ecological Environmental Construction edited by Shao Mingan.74-79, Xiaan, Shanxi Science and technology press. http://ir.igsnrr.ac.cn/handle/311030/4789

[6] Guo Z. & Shao, M. 2003. Vegetation carrying capacity of soil water and soil desiccation in artificial forestry and grassland in the semiarid regions of Loess Plateau. Chin. J. ECOL. 23, 1640-1647.http:// en.cnki.com.cn/Article_en/ Cjfdtotal-STXB200308023.htm

[7] Guo Z, & Shao M. 2004. Mathematical model for determining vegetation carrying capacity of soil water. J. Hydr. 35 (10): 95-99.

[8] Guo Z. & Shao M. 2010a. Effect of Artificial Caragana korshinskii Forest on Soil Water in the Semiarid Area of Loess Hilly Region. Chin. Forest SCI. 46: 1-8.

[9] Guo Z. & Shao M. (2013). Impact of afforestation density on soil and water conservation of the semiarid Loess Plateau. J. SOIL WATER CONSERV.68, 401-410. https://doi.org/10.2489/jswc.68.5.401

[10] Guo Z, & Zhang W. (2016) Impact of Initial Planting Density on Soil Water Resource uses Limit by Plants. Geoinfor Geostat: An Overview 4:1. https://doi.org/10.4172/2327-4581.1000137

[11] Guo Z. 2009a. Limit of vegetation rehabilitation for soil and water conservation in semi-arid region of Loess Plateau. Chin. J. Science Soil Water Conserv. 7: 49-54 //en.cnki.com.cn/ Article_en/ Cjfdtotal-STBC200904010.htm.

[12] Guo Z. & Li Y. 2009b. Initiation stage to regulate the caragana growth and soil water in the semiarid area of Loess Hilly Region, China. Chin. J. ECOL. 29, 5721-5723. http://www.oalib.com/paper/1402580#.XhRXA_ZuKUk.

[13] Guo Z. 2010b. Soil water resource use limit in semi-arid loess hilly area. Chin. J. App. Eco. 21, 3029-3035. http://connection.ebscohost.com /c/articles/63484494/soil-water-resource-use-limit-semi-arid-loess-hilly-area

[14] Guo Z. 2014. Theory and Practice on soil water carrying capacity for vegetation. 45-100(Chin. Scientific Press). //www.geobooks.com.cn.

[15] Guo Z. 2019. Rice carrying capacity and sustainable produce of rice in resources-limited regions. Int. J. Agric. Sc. Food Technol. 5(1): 054-057. https://doi.org/10.17352/2455-815X.000042

[16] Guo Z. 2020. Estimating Method of Maximum Infltration Depth and Soil Water Supply, Scientific Reports, 10(1): 9726 https://doi.org/10.1038/s41598-020-66859-0

[17] Guo Z. 2021a. Soil water carrying capacity for vegetation. Land degradation development. 32(14): 3801-3811. https://doi.org/10.1002/ldr.3950

[18] Guo Z. 2021b. Soil hydrology process and Sustainable Use of Soil Water Resources in Desert Regions. Water, 2021; 13(17): 2377. https://doi.org/10.3390/w13172377

[19] Guo Z. 2022.High-quality development of agriculture Encyclopedic Forrum. 2022; (01): 64-66.

[20] Guo Z. 2023.Forest restoration, resources sustainable use and high-quality sustainable management. Glob J Ecol.2023, 8(1): 007-010. https://doi.org/10.17352/gje.000075

[21] Lvovich M.I. 1980. Soil trend in hydrology. Hydrological Sciences Bulleting. 25: 33-45 . https://doi.org/10.1080/02626668009491902

[22] Price D. 1999. Carrying capacity reconsidered. POPUL ENVIRO. 21: 5-26. http://connection.ebscohost.com/c/ articles/ 2319084/ carrying-capacity-reconsidered https://doi.org/10.1007/BF02436118

[23] Young CC. 1998. Defining the range: The development of carrying capacity in management. J. Hist Biol. 31: 61-83. http:// www. doc88.com/ p-3703879579543.html https://doi.org/10.1023/A:1004205522191

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