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Mini Review

Sustainable Use of Soil Resources and Agriculture High-Quality Development

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Abstract

As economy develops and population increase, there is an increasing demand for plant goods such as timber, food, medicine and so on and ecological service such as clean air, fresh water and environment. Because plant goods and service produced 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. As plant grow, soil and vegetation degradation and crop failure will happen because vegetation overload and overuse of soil resources or waste of soil resources. To solve these problems, after ten years of research, the results showed that there is a soil resource use limit by plants, vegetation carrying capacity and 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.

The vegetation carrying capacity includes space vegetation carrying capacity, soil water vegetation carrying capacity and soil nutrient vegetation carrying capacity 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 key 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 critical period of plant resources relation regulation, the plant resources relation must be regulated on the vegetation carrying capacity to get maximal yield and beneficial effect and realize sustainable use of soil 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

Ince 2017, China put forward the concept of high-quality development, agriculture development had entered the new time of high-quality development of agriculture. Agriculture high-quality development is to take some measures and methods to make the land produce the maximum output and services to meet people's yearning for a better life and the needs of agricultural production services [1]. As economy develops and population increases, 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 [2] and the world has become farmland, man-made forest and grass 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 [3]. To solve these problems 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 and the carrying capacity of soil water to vegetation the method of high quality and sustainable management of forest vegetation in water shortage area in the process of vegetation restoration [4-6]. The change of precipitation with month and year in semiarid loess hilly region (Guyuan. China) (Figure 1). The main contents are as follows:

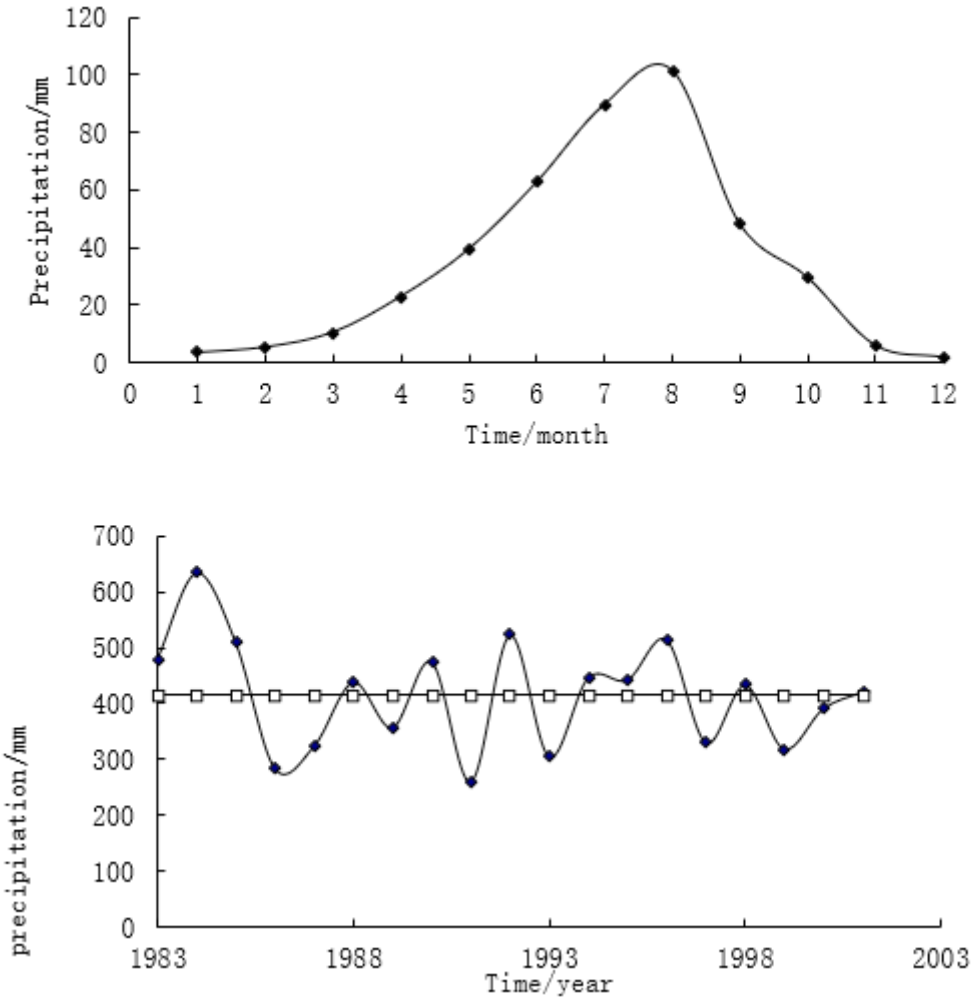

Figure 1: Change of precipitation with month (photo above) and year (photo below) in semiarid loess hilly region (Guyuan. China).

The Theory of use Limit of Soil Resources by Plants

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 are declined. To obtain maximum yield and beneficial result and achieve high-quality and development, even the root distribution depth is more than the maximum infiltration depth (Figure 2), plant roots do not absorb water indefinitely due to lack of water such as in semiarid loess hilly region (Guyuan. China) the precipitation changes with year and month (Figure 1) [7]. 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 [8] It is the soil water storage when the soil water content is equal to the wilting coefficient in the range of the maximum infiltration depth. The wilting coefficient at different soil depth in the maximum infiltration depth can be determined by centrifugal machine or press film.

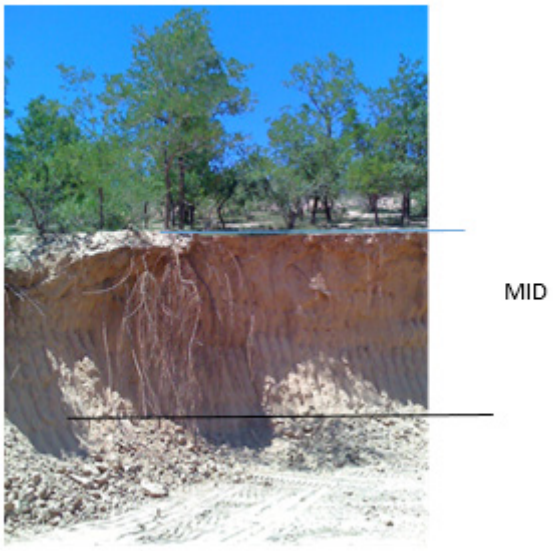

Figure 2: The Robinia pseudoacacia L. root distribution depth and maximum infiltration depth (MID) relationship. The MID is 290 cm in semiarid loess hilly region (Guyuan, Ningxia China).

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 [9]. The wilting coefficient is expressed by the wilting coefficient of indicating plants in a plant community. The indicator plants of natural vegetation are the predominance species, especially the predominance species in the top canopy of plant community, 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 [10]. At this time, the regulation of plant-water relationship should be considered be regulated. The initial planting density influences the soil water resource use limit by plants [11].

Theory of Vegetation Carrying Capacity

Vegetation carrying capacity is the ability of land resources to support vegetation, which is limit. The vegetation carrying capacity is the soil water vegetation carrying capacity, which is the ability of soil water resources to support vegetation and limited in water shortage area. The soil water carrying capacity for vegetation [12]. 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 [13] and can be estimated by soil water plant density model, 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.

Critical Period of Plant- Resources Relationship Regulation

Generally, along with plant growth, the available solar resources amount is limit in given canopy (cube) such as leaf amount in given canopy or soil water resources in 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 must 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, soil preparation such as thin film cover and ridge tillage in the semiarid loess hilly region (Guyuan. China) (Figure 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.

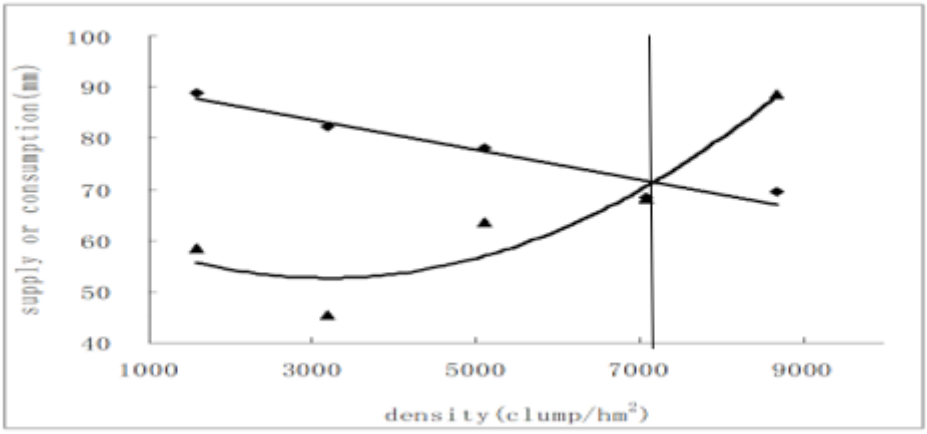

Figure 3: The plant density and soil water supply or consumption relation and soil water vegetation carrying capacity in the critical period of plant water relation regulation.

If the available resources in the canopy are 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. 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.

High Quality and Sustainable Management of Forest

Firstly, the better plant species and varieties must be selected according to site condition and cultivation goal [14] and then suitable initially planting density must be taken. The initially planting density is more than soil water carrying capacity for vegetation such as soil water carrying capacity for vegetation in water-limited regions. If the existing plant density is more than soil water vegetation carrying capacity 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 non-commercial forest and grass can be obtained by determining and controlling the plant-water relationship according to the soil water carrying capacity for vegetation in the critical period of plant water relationship regulation. The high quality and sustainable development can be achieved in water-limited regions [15-17].

Conclusion

The most important work of forest restoration is the plant-resources relationship regulation in the process of plant growth, especially plant-resources relationship regulation in the critical period of plant resources relationship regulation such as plant-water relationship regulation in the water-limited regions because the plant-resources relationship decides the maximum yield and benefit of a population or plant community [18]. The theoretical foundation of plant-resources relationship regulation is resources use limit by plants, vegetation carrying capacity and critical period

of plant resources relationship regulation [19]. When the soil resources amount reduced to utilization limit of soil 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 by plants, 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 [20-24]. At this time, the plant resources relationship should be regulated to obtain the maximum yield and benefit of non-native vegetation, such as forest, grass and crop to carry out sustainable use of soil resources and agriculture high-quality development.

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Conflict of Interest

No conflict of interest.

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