



Agricultural Production and the Need of Market

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Abstract

Agricultural development has entered a new stage of high-quality growth. High-quality agricultural development belongs to adopt effective measures and methods to enable the land to generate the maximum output and services and meet people's aspirations for a better life and agricultural production services. The theoretical basis for high-quality agricultural development lies in the utilization limit of plant resources, the carrying capacity of vegetation, and the critical period for regulating the relationship between plant resources. This includes the utilization limit of plant spatial resources, the carrying capacity of spatial vegetation, and the critical period for regulating the relationship between plant spatial resources in areas rich in soil moisture and soil nutrients. The critical period for regulating the limit of plant soil water resource utilization, the carrying capacity of soil moisture and vegetation, and the relationship between plants and water in water-restricted areas. The approach to high-quality agricultural development lies in selecting the best seeds or varieties, determining the appropriate initial planting density, regulating the relationship between plant resources to ensure plant grow well and achieve the quality, maximum yield and benefits to realize the sustainable utilization of natural resources and high-quality agricultural development.

Keywords: Agriculture high-quality development; resources use limit by plants, vegetation carrying capacity; critical period of plant resources relationship regulation; quality; healthy; yield and benefits; sustainable utilization of natural resources

1. Introduction

Agricultural development has gone through a long process. According to the efficiency of resources plants use, the process can be divided into three stages, original agriculture stage, yield and quality increasing stage and Agriculture high-quality development.

Plant-based agricultural products: including grains, vegetables, tobacco leaves, tea, horticultural plants, etc. Plant-based cosmetics: using plant extracts as the main raw materials, such as aloe vera, green tea, rose, oatmeal, etc., emphasizing natural ingredients and environmental protection characteristics.

Cereal crops are also called "edible crops" or "grain crops". In China, they are collectively referred to as cereal crops, tuber crops (including sweet potatoes, potatoes, etc.) and edible legume crops (including soybeans, broad beans, green beans, small beans, etc.).

They are generally used as the main food for humans. In terms of nutrition, cereal crops mainly provide starch, protein, vitamins, etc., legume crops mainly provide protein, fat, etc., and tuber crops mainly provide starch, vitamins, etc. These crops are also the premium feed for livestock, with a huge demand and a large cultivation area and proportion. Vegetables refer to a type of plant or fungus that can be used for cooking and making food, and are an indispensable part of human daily diet, rich in various vitamins, minerals, dietary fiber and phytochemicals. Leafy vegetables: Chinese cabbage, spinach, rape, lettuce, etc.

Different vegetables are rich in different nutrients. For example, spinach is rich in iron and vitamin A, and rape is rich in vitamin C and calcium. Root and stem vegetables: carrots, potatoes, yam, lotus root. Carrots have beta-carotene to protect eyesight, and potatoes are a high-quality source of carbohydrates.

Fruit and vegetable crops: cucumbers, winter melons, bitter gourds, pumpkins, etc. They have high water content and a refreshing taste, suitable for summer.

Legumes: soybeans, green beans, red beans, green beans, etc., are important sources of plant protein.

High quality agricultural products refer to agricultural products that are favored by consumers in terms of appearance, nutrition, taste, flavor, and other aspects. According to different standards and definitions, high-quality agricultural products can include the following aspects:

Safety standards: High quality agricultural products must first meet the requirements of safeguarding human health and safety, which are guaranteed by laws and regulations such as the Agricultural Product Quality and Safety Law of the People's Republic of China. According to monitoring in the first half of 2026, the pass rate of routine monitoring of major agricultural products reached 97.1%.

Green and high-quality agricultural products: The Ministry of Agriculture and Rural Affairs will optimize the supply of green and high-quality agricultural products from three aspects, including expanding the total quantity and promoting high quality. The pass rate of routine monitoring of agricultural product quality and safety in the first half of 2025 will remain at a high level of 97.9%. Since the 14th Five Year Plan, 36000 new certified green, organic, famous, special, excellent, and geographical indication agricultural products have been obtained, covering categories such as rice, flour, oil, meat, eggs, milk, fruits, vegetables, tea, and aquatic products. The total amount of green and high-quality agricultural products provided to society each year exceeds 200 million tons.

Quality evaluation system: Panda Guide, as a high-quality agricultural product evaluation system under Syngenta Group China, has continuously released industry rankings for 9 years. The 2026 ranking covers 8 major categories, with a total of 477 agricultural products on the list. The number of high-grade products is steadily increasing, demonstrating the continuous enhancement of China's agricultural quality supply capacity.

Market performance: Some high-quality agricultural products such as Qin crisp apples and European plums have performed well in the market due to their stable flavor performance and market adaptability, driving farmers to switch crops and increasing sales by 14%.

In summary, high-quality agricultural products not only need to meet safety and quality standards, but also need to perform well in terms of taste, flavor, and market adaptability. With the upgrading of consumption and policy guidance, the supply capacity and

market influence of high-quality agricultural products are constantly improving.

However, because land use change, overuse of fertilizer and pesticide alters the plant resources relationship, easily resulting in soil and vegetation degradation and crop failure because of overload, or resources waste because of low load, both are unfavorable for the sustainable utilization of nature resources and crops high-quality production. Therefore, it is necessary to select excellent species or varieties according to the site condition and the market need, adopt appropriate initial planting density, and take effective measures, such as weeding, fertilizing and watering and so on to regulating the relationships between plant growth and resources supply and consume in the process of crop production to obtain the maximum yield and benefits and realize the sustainable utilization of natural resources and achieve high quality agricultural production.

3.Theoretical Foundation for High-Quality Development of Agriculture

The theoretical foundations of Agriculture high quality development include resources use limit by plants, vegetation carrying capacity and the critical period of plant resources relationship regulation, which include space resources use limit by plants, space vegetation carrying capacity and the critical period of plant space relationship regulation in soil water and nutrient rich regions; soil water resources use limit by plants, soil water vegetation carrying capacity and the critical period of plant water relationship regulation in water-limited regions and soil nutrient resources use limit by plants, soil nutrient vegetation carrying capacity and the critical period of plant nutrient relationship regulation. In this paper, take the semiarid region as an example to introduce the theoretical foundations of Agriculture high-quality development (Guo 2022, 2024, 2025). The details are as following:

3.1 Resources use limit by plants

The nature resources are limit on the earth, so, the use of what plant use nature resources is limit, the limit is resources use limit by plants, which includes the spaces resources use limit by plants and spaces vegetation carrying capacity and critical period of plant space relationship regulation in soil water and soil nutrient enough regions; soil nutrient resources use limit by plants and soil nutrient vegetation carrying capacity critical period of plant nutrient resources relationship regulation in nutrient limited regions and the soil water resources use limit by plants (SWRULP) and soil water vegetation carrying capacity (SWVCC) and the critical period of plant resources relationship regulation in water limited regions. The critical period of plant resources relationship regulation is the critical period of plant water relationship regulation in water limited regions Because the main factors affecting plant growth are different in different regions.

Nature resources is the foundation of Agriculture high-quality development. Nature resources is the Soil water resources in water-limited regions.

Soil water resources proposed by Budagovski in 1985 (Budagovski 1985), is a good resources. The resources use limit by plants is the soil water resources in the maximum infiltration depth (MID) when the soil water content in every soil layer equal to wilting coefficient, which changes with vegetation type and site condition. For example, the precipitation changes and the infiltration depth change with time in the Red Plum Apricot

Orchard in semi-arid loess hilly region (Guyuan, China). The soil water suction change with soil water content at the same soil depth (Guo 2010, 2022).

Briggs and Shantz (1912) emphasized the importance of the wilting coefficient. Richards and

Weaver (1943) observed that soil water potential at wilting ranged from -0.1×10^6 to -0.2×10^6

MPa, with an average of approximately -0.15×10^6 MPa (15 bar).

Therefore, the water content at -0.15×10^6 MPa is the point at which soil moisture usually becomes limited severely (Kramer, 1983, Parchami-Araghi et al., 2013). The wilting coefficient is equal to the soil water content when soil water suction is equal to 15 Ba because the wilting coefficient changed with plant species with a range from 10 Ba to 20 Ba, which change with soil depth and expressed by the wilting coefficient of indicate plant in a plant community.

3.2 Vegetation carrying capacity

Vegetation carrying capacity (VCC) is the ability of land resources to support vegetation, which was expressed by the population or density of indicator plants in a plant community and changes with vegetation type, time (climate change) and site condition (Guo et al, 2002; Guo & Shao 2003, 2004; Guo 2004, 2010, 2014,2022). Vegetation carrying capacity includes spaces vegetation carrying capacity in soil water and nutrient rich regions, Soil nutrient vegetation carrying capacity and soil water vegetation carrying capacity (SWVCC) (Guo and Shao, 2004, 2013; Guo 2004, 2014, 2019, 2021,2025).

3.3 The critical period of plant resources relationship regulation

The plant resources relation change with plant growth since planting or sowing in a giving site condition. When the size of plant is small, the plant available resources in crown or root are smaller than the resources use limit by plants, the plant resources relation is good and plant grow well. If the plant available resources in crown or root is equal to the resources use limit by plants, the plant resources relation enters the critical period of plant soil relationship regulation. The ending time of the critical period of plant resources relationship regulation is the ineffective time of regulating plant resources relation. The critical period of plant resources relationship regulation includes critical period of plant space relationship regulation in soil water and soil nutrient enough regions, the critical period of plant nutrient resources relationship regulation in nutrient limited regions and the critical period of plant resources relationship regulation in water limited regions. For example, in water limited regions, the soil water resources are the most important resources influencing plant growth. the critical period of plant resources relationship regulation in water limited regions is the critical period of plant water relationship regulation in water limited regions in semiarid loess hilly region. The ending time of red plum apricot is stop expanding on 15 July, So, the ending time of the critical period of plant resources relationship regulation for the red plum apricot is the 15 July. The critical period of plant resources relationship regulation for the caragana shrub in semiarid loess hilly region is the end of September because caragana shrub is soil and water conservation forest, which stop serving as conservating soil and water in the raining period.

Because the main factors affecting plant growth are different in different regions.

If the soil water resources in the MID in the critical period of plant soil relationship regulation soil water resources is lower than the SWRULP, the plant water relation enters the critical period of plant soil relationship regulation (CPPSRR) (Guo 2019, 2021) .At this stage, we should care about the plant resources relation.

The end time of CPPSRR is the failure time of the regulation of plant-soil relationship. The critical period for regulating the relationship between red plum and apricot plants and soil ends in July 15 because at this time, red plum apricot stops expanding and for caragana is the end of September because caragana stops serving in the Loess hilly region. The relationship between plant density and soil water supply and soil water consumption in the critical period of plant soil relationship regulation in caragana shrubland of semi-arid loess hilly region (Guyuan, China), see fig.4.If present plant density is more than SWVCC in the critical period of plant soil relationship regulation, plant water relationship has to be regulated based on SWVCC to get the maximum yield and service. For fruit trees or crops, the relationship between vegetative growth and reproductive growth should be reregulated according to the suitable leaf when the present plant density in the critical period of plant resource relationship regulation is equal to the vegetation carrying capacity, and the leaf and fine fruit relationship to obtain the maximum yield and benefits.

4.The method of Agriculture high-quality production

To carrying out Agriculture high-quality development, we should take some effective measures and method. The basic methods of Agriculture high-quality production as following:

4.1 Selection of better species or varieties

First, we must select better species or varieties according to the site condition and market need because different fruit tree produce different fruit, and better species or varieties influence the yield, quality and economic effect and market influence the marketing of production. For example, in semiarid loess hilly region, after a couple of yeas research, the red plum apricot has been selected as the better species and promoted in large scale (Shi and Guo 1995), See Fig.1.According to the market investigation in the 29th China Yangling Agricultural High-tech Achievements Expo, the fine apple cultivated by Luochuan fruit farmers is the fine apple with the diameter equal to or more than 90 cm. It is a good apple but it is a little bigger, one cannot eat an apple one time, so it is little big more and one cannot eat an apple a time, 85 apple is good,. According to the investigation in Sichuan, China, the standard of prickly ash is different in Taiwan, Macau and Hongkong. We should take effect



Fig.1. The flower and fruit of red plum apricot in the semiarid loess hilly region (left photo is flower in May and Right photo is fruit in July)



Fig.2. The 29th China Yangling Agricultural High-tech Achievements Expo Luochuan Apple Market Research (The left picture shows the Luochuan apple market research in May, and the right picture shows the high-quality apples grown by Luochuan fruit farmers.

measure to produce different quality production and meet the need of different market, see fig.2

4.1 Take suitable Initial planting density

Planting density influences the plant growth and yield and service. If the Initial planting density is smaller, which influence the yield and benefits, so we must take the suitable initial planting density. The suitable initial planting density is equal or more than vegetation carrying capacity, especially the vegetation carrying capacity in critical period of plant resources relationship regulation because it is easier to reduce the plant density in the process of plant growth and use the natural resources in sustainable way. For example, the suitable initial planting density of caragana in semiarid loess hilly region, is 6500 trees per 100 m², and the sowing seed is 1.5 kg per 100 m². As for one year plant, such as pepper, see Fig.1, we can estimate the suitable Initial planting density according to the crown area per one standard plant with big fruit. The standard plant is a good plant with a maximum crown, yield and beneficial effect (Guo, 2025).





Fig. 7. Taking the standard plants in Xunhua area, Qinghai Province, China in March 2023 as an example, the estimation method for the suitable initial planting density of peppers was introduced to the local people. The picture on the right shows a standard plant of chili peppers, which is 60 cm tall and has a canopy of 30cm×40cm, with the highest yield and service quality.

4.3 take effective measures to make plant grow well and get the cultivate goal

We should take effective measures, such as weeds, fertilizer and so on because the weeds, fertilizer and water affect plant growth. In order to make plant grow well and get the cultivate goal we can get the quality fruit and expected nutrient, we must take effective measures such as weeding, fertilization according to the appropriate amount of fertilizer, irrigation according to the water requirement of plants and promote plant growth to get maximum yield and benefit to carry out cultivated goal. If available resources in crown layer in water and nutrient rich regions or root zone in water-limited regions or nutrient limited regions decrease to the limit of resource utilization by plant, the plant water relation enters the critical period of plant resources relation regulation. If the plant density exceeds the vegetation carrying capacity in the critical period of plant resources relation regulation, the plant resources relation should be regulated according to vegetation carrying capacity in the critical period of plant resources relation regulation (Guo 2014,2021). We should take effective measures, such as weeding, rational fertilizing and irrigation (if having water resources) to ensure plant growth well in the process of production and get the cultivated goal. The cultivated goal is the need of market for production. if the production does not meet the need, you cannot get the benefit. If the plant density is more than the vegetation carrying capacity in the critical period of plant resources relation regulation, showing that the plant resources relationship should be regulated, otherwise the further increase of natural resources used by plant will lead to the decline of vegetation and the decline of grain yield and quality (Guo et al, 2002; Guo & Shao,2003, 2004, 2010, 2013; Guo 2014; 2021 and 2021, 2022, 2023, 2024, 2025).

Conclusion

Agriculture development has lasted a long time and now entered the stage of high-quality development, which is to take effective 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 and services. High-quality development of agriculture is the foundation for high-quality economic and social development. The theoretical basis for high-quality agricultural development lies in the limit of plant resource utilization, the carrying capacity of vegetation, and the critical period for regulating the relationship between plants and resources. This includes the limit of plant spatial resource utilization, the carrying capacity of spatial vegetation, and the critical period for regulating the relationship between plants and spatial resources, as well as the limit of plant-soil-water resource utilization and the critical period for regulating the carrying capacity of soil-water-vegetation and the relationship between plants and water. Moreover, the utilization of soil nutrient resources is restricted by plants, and soil nutrients are affected by the relationship between the carrying capacity of vegetation and the regulation of plant nutrients during critical periods. The approach to high-quality agricultural development is to select superior tree species or varieties, adopt appropriate initial planting densities and effective measures to ensure that plants grow well during the production process and achieve the cultivation goals. From now on, it is necessary to strengthen basic agricultural research, determine the critical periods for adjusting the utilization limits of plant resources, the carrying capacity of vegetation and the relationship between plant resources at different sites and for different plant species, and then adopt methods for high-quality agricultural production to select the best plant species or varieties. Adopt appropriate initial planting density and effective measures to ensure good plant growth, achieve maximum yield and benefits, and realize the sustainable utilization of natural resources and high-quality agricultural development.

Because of the large agricultural area (Keiblinger et al., 2023) and the increasing population, which has exceeded 8.2 billion at present, different regions have different crops species or varieties suitable for growth, so it is necessary to establish demonstration site of agriculture high-quality development in different regions to strengthen the research on agricultural high-quality development to meet people's needs for a better life and crop types, yields and quality. At present, I am leading the "innovation China", agricultural high-quality production and industrial service group to widely publicize and promote the new theories of the agriculture high-quality development, the theories of resource utilization limit, vegetation carrying capacity theory and the critical period theory of plant resource relationship regulation and take effective methods or measures to carry out sustainable use of resources and agriculture high-quality development to serve food security, people's healthy, rural revitalization and the construction of beautiful world.

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