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Discussion on the Perspective of Wheat/Alfalfa Intercropping in the Wheat Conservation Tillage

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Abstract: Wheat and alfalfa intercropping is a kind of ideal model of modern ecological agriculture. As a perennial bird's-foot, Alfalfa has leguminous ability of nitrogen fixation. Use this character, we can intercropping it with wheat to fully utilize natural recourses of soil, water and radiation after harvestry of wheat. Through proper field management, we need control alfalfa's growing to avoid adverse effect to normal wheat productivity. Together with refined processes for alfalfa and shed feeding for inland stockbreeding, the intercropping could realize the ideal of favorable eco-agricultural developing, enhance foodstuff producing efficiency and people's living standard in wheat producing areas.
Keywords: Wheat, Alfalfa, Conservation Tillage, Intercropping

INTRODUCTION

At present wheat conservation tillage technology has been promoted and applied in the production practice in China with its many ecological and economic effect being preliminary confirmed. Reasonable intercropping with rotation is an important part of conservation tillage technology. Introducing alfalfa, widely cultivated perennial leguminous forage, into wheat conservation tillage technology system to promote the development of food and agriculture is of great significance. But this aspect of exploration in the scientific research and production practice rarely used, especially in the major wheat producing areas, for fear of affecting the production efficiency. This article summarized the existing intercropping planting technology and the development of conservation tillage technology as well as the wheat tillage practice in China, combining the researcher's understanding of three kinds of legume forages during the Dr study period, expounded the application prospect of introducing perennial leguminous forage alfalfa into wheat production system as a kind of protective living cover crops, in order to provide scientific ideas and basis for the development of ecological agriculture by advocating a new way of comprehensive utilization of agricultural resources.

THE MEANINGS AND FUNCTIONS OF INTERCROPPING PLANTING

Intercropping is the major component of multiple cropping and is widely used in intensive production area. Its purpose is in a limited time harvesting two or more economic yields of crops on the limited land area to reduce stress and market risk. According to a rough estimate, the world intercropping area of more than 100 million hm^2, on the premise of no expansion of land area, has made significant contribution in solving the problem of food and clothing of the world's population by improving food production[1].

Basic biology principle shows that when two crops grow together, there is concurrence of competition and promotion. Among various kinds of intercropping system, when the competition effect is less than the promotion role will show the intercropping advantage; while when the competition effect is greater, it will be characterized by intercropping disadvantage[2]. Endeavour of obtaining the intercropping advantage is the consistent pursuit of all intercropping system. Wherefore the studies revealing different crops and crop varieties' resource competition ability and characteristics discrepancy, relationships and mechanisms between diversified crop composition or variety arranged in pairs or groups and intercropping advantage exertion are particularly important and prevail at home and abroad. The more consistent results and conclusions are as follows:

The light energy utilization of intercropping systems

The composite colony structure characteristics of intercropping are peculiar in improving the efficiency of light interception and conversion[3]. Such as intercropping population increased energy use and production by increasing leaf area index and extend the photosynthetic time. Again for instance, C4 plants have high light saturation point, while C3 plants to low

energy radiation use efficiency is high, the two types of crops grow together can improve light utilization condition and raise the utilization rate.

The nutrient utilization of intercropping systems

In the intercropping systems, due to the differences of sensitive degree and competition ability for nutrients, differing ripening time and the using peak time for nutrients, and also the distinctness in physiological and biochemical characteristics, the depth and distribution of roots, the compound groups could make use of diverse forms of nutrients in different levels and areas of soil, and, thus reducing the competition effect between crops, promoting the formation of nutrient use advantage[4-6].

The water utilization of intercropping systems

Scientific and reasonable intercropping systems usually have commonly using and intermodulation mechanisms for seasonal water surplus and deficiency during the symbiotic period, thus have obvious advantages of water use efficiency and creating the suitable soil moisture environment [7-8]. Furthermore, the difference between the composite groups' absolute water consumption and the weighted average value of the monocultures water consumption is small, changing between - 6% ~ + 7% [9, 10].

The crop yield and quality of intercropping systems

Rational intercropping is propitious to increase production. Under low production level, interplant can increase the stability of production, reduce agricultural investment and improve soil fertility; under a higher level of production, mixtures of crops can make full use of resources, increase the crop output and reduce the occurrence of pest and disease[1-2]. Researches of impact on crop nutritional quality focus on the effects on crude protein content. Carr's barley and oat intercropping with pea's research results show that compared with the same or higher density monoculture, pea production was not affected, but crude protein content increased significantly, and when the composite pea's ratio increased, the difference was more apparent[10]. According to Martin, maize and soybean intercropping could obviously increase the straw CP content than monocultures[11].

The pest and disease control of intercropping systems

Application of interplant could improve the utilization rate of land, improve the economic benefit by complementary efficiencies, and to a certain extent, reduce insect pest[12]. The reason on the one hand is the vegetation diversity in farmland ecosystems can stable insect populations, on the other hand is a variety of crop mineral nutrient coordination and control as a result, which has the best nutritional status of plants has the biggest disease resistance. As mentioned earlier, intercropping has significant advantages on the nutrient uptake than monoculture, so that the compound groups also have good nutritional status. Intercropping system has become an important part of comprehensive system of biological control for plant diseases and insect pests.

THE POPULARIZATION AND APPLICATION OF CONSERVATION TILLAGE TECHNOLOGY

Conservation tillage, mainly with the less-no-till techniques, was developed gradually since the middle of the 20th century and was given priority to as an advanced cultivation technology system in virtue of preventing water loss and soil erosion, enriching the soil fertility, improving the efficiency of resource utilization and increase production[13]. For nearly 30 years, with the development of agricultural machinery and a variety of herbicides, represented by zero tillage conservation tillage methods in the United States, Canada and Australia and other developed countries have been largely tested and promoted, even in South Asia, where rice planting predominant, have also been gradually accepted and continuously explored as the new farming idea and pattern[14].

The '50 s and' 60 s of the 20th century in our country, began to carry out the protective cultivation technologies in experiment research and agricultural research. In 1992, in view of lack of water resources and the necessary to develop rainfed, China agricultural university, cooperating with farm machinery office in Shanxi Province and the University of Queensland, began to introduce and explore conservation tillage technology in parts of shanxi loess plateau referencing to Australia. After ten years of continuous test, has completed the conservation tillage adaptability research in our country, putted forward in annual practice area the suitable mechanized conservation tillage technology, and promoted in 10 provinces and cities in the north of China [15]. Throughout summarizing the experiment and promotion process of conservation tillage technology in China, it is essentially the transformation from traditional agriculture to modern agriculture of practice. Experienced half a century of exploration, experiment and promotion, conservation tillage technology in our country has been basically supported and accepted from top to bottom theoretically and practically. It is also the main direction of agricultural sustainable development in the future.

The basic principle of conservation tillage[16] is to improve soil fertility and water pervasion-storage capacity by increasing the surface roughness and meliorating soil structure; to achieve the purpose of attaining high and stable yield, enriching the soil fertility, protecting soil and soil water with vegetation coverage reasonably increased, that helps to intercept rainfall, reduce moisture evaporation, increase surface water infiltration time and prevent the occurrence of runoff. In order to increase the surface coverage of crop, rotation, intercropping and mixed interplant together with the reduced tillage (including no-till deep loosening and minimum tillage with coverage) and

none-tillage, giving priority to change the soil physical properties, are two kinds of rapidly taking effect but less engineering protective measures. Whether efficaciously combining the two, playing their respective advantages to acquire the effect of both production and efficiency, is the most worth exploring theme.

THE IMPORTANT VALUE OF WHEAT/ALFALFA DOUBLE SYSTEM IN WHEAT CONSERVATION TILLAGE

'Wheat conservation tillage technology is a mechanization farming system taking mechanical work as the main means, adopting less tillage or no tillage methods to protect soil, reduce production cost and realize sustainable development of agricultural [17]. Actually not only in wheat, other crops (rice, corn, soybean, rapeseed, cotton, etc.) conservation tillage practice at present basically are in such a state, that given priority to modernization of reduced tillage and minimum tillage with cover, supplemented by chemical weed control. It is also the United States and other developed countries went across in agricultural modernization. By and large it is a variation of industrial production, resulting in the pollution and damage to the ecological environment. For the problems exposed by the modernization of agriculture in the United States, after years of exploration, it was concluded that the only countermeasures is to gradually restore the penetrating ecosystem into the way of agricultural production of the past, i.e. gradually push 'Low input Sustainable agriculture' ('Lisa' for short) mode of production[18-19].

As is known to all, alfalfa is a good forage grass, with 7 times protein content and more than twice over digestible energy of wheat grain, also a lot more vitamins, minerals, trace elements, and to promote the activity of reproduction and growth substances. Alfalfa is not only able to provide a large number of high-quality forage, but will also bequeath a lot of root with nodule legacy in the soil, which improve soil structure and physicochemical property and the soil fertility[20]. Studies have shown that there have 9 000 kg/ hm^2 roots in planted three years alfalfa soil, of which about 47% distribution in 0 ~ 30 cm topsoil making the organic matter increased by 0.1% ~ 0.3% [21]. It could increase the after crop grain production by 30%, or even 1 ~ 2 folds [22]. As a typical perennial bird's-foot, alfalfa can be used for years after planting; also don't interfere with the large-scale machinery operation, very suitable for as a conservation tillage system - species selection in major wheat producing areas. This is beneficial not only to promote the wheat production, but also can make full use of and improve the field ecological environment and resources. With the combination of the animal husbandry and sideline to improve the economic benefits of growers, for wheat production in China and the goal of the sustainable development of agriculture is of great significance and considerable prospect.

It is showed in a master's research report of Northwest Sci-Tech University of Agriculture and Forestry[23] that intercropping alfalfa into wheat significantly improved the wheat yield since enhanced control effect for the dominant herbivore Macrosiphum avenae by optimizing the assemblage of biocontrol agents. There have some else wheat intercropping alfalfa obtaining remarkable economic benefit research reports in our country and abroad[25-28]. But many experts and scholars are disinclined to accept implementing this farming system in the major wheat producing areas, mainly because of worry about alfalfa's competition of strong growth ability affects the growth of wheat and production capacity, or about discommodiousness of mechanized farming on large scale costs wheat production efficiency reduce. This is indeed a fundamental problem that wheat - alfalfa cultivation system have to face and solve, but it also should be the impetus to promote our perfecting wheat conservation tillage technology, achieving the purpose of harmonious development of economic, social and ecological sustainable production.

CONCLUSIONS

To sum up, wheat/alfalfa interplant in theory and on the actual development prospects have absolute advantage. Introducing alfalfa as a living cover plant into wheat field, making full use of its perennial and nitrogen-fixing features, under the premise of not affect the wheat production, developing agronomic animal husbandry industry, is an ideal new wheat conservation tillage technology development direction. It very accords with the concept of agricultural sustainable development and is worthy of study. But because such an ideal planting pattern has long been constrained by its heavy and complicated operation and the contradiction with modern agricultural mechanization production, so far has not been set store by the experts and scholars. Therefore it needs to combine the field observation and indoor analysis to study the cooperation and competition mechanism and performance of wheat and alfalfa in the intercropping system. We are supposed to obtain mass and credible experimental results to answer the questions as follow: Introduce the alfalfa into wheat field will produce what kind of ecological effect? Will it affect the wheat production? To what degree if it will? Or is it a positive or negative effect? Whether can through scientific management to solve the problems?

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