Research and Application of Peat in Agriculture

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Abstract. Peat has excellent permeability, good hydrophilicity and strong activity and wide range of applications in agriculture, which is a loose fibrous natural biomass material, in the paper, the research and application of peat as soil amendment, fertilizer and horticulture were elaborated in detail, and the application prospect of peat in agriculture was prospected.

1. Introduction
Peat, also known as turf, grass coal and so on, which is an organic soil formed by inadequate biochemical decomposition of dead plant remains, mostly black or brown in marshes. Peat is an important natural resource, and 70% of the world's peat reserves are used in agriculture. Peat in China is one of the largest countries with rich peat resources in the world. At present, the total reserve of peat is 5 billion tons [1]. Peat is a kind of special material of natural biomass with loose fibers. Porous pore makes peat have large specific surface area and strong adsorption capacity [2]. Therefore, peat has the advantages of good permeability, good hydrophilicity and strong activity. With the progress of science and technology and the rapid development of industry and agriculture, peat plays a greater role in agriculture as soil improvement additive, fertilizer and horticultural cultivation medium. The paper mainly summarizes and analyses the research and development and application progress of peat in these three areas in recent years, and provides a reference for the wider research and development and application of peat in agriculture.

2. Natural peat as additive of soil amendment

2.1. Effect on Soil Physical and Chemical Properties
Peat in natural state mainly exists in three states: peat water, minerals and organic matter. Among them, peat water has the most content, which could up to 65%, and has the strongest activity. Due to its rich organic matter, rich cellulose, porous, strong ion exchange capacity and salt balance ability, peat water plays an important role in regulating the physical and chemical properties of soil [3].

It was found that the physical and chemical properties of sandy soil changed significantly when peat was added. Because peat contains a large amount of humic acid, it has a strong acidity regulation ability. In addition, after adding peat to the turf bed, its permeability also changes. With the increase of
peat amount, the permeability rate decreases slowly (Table 1). After adding 25% peat, the permeability coefficient decreases the smallest (0.55), indicating that the soil water-holding capacity reaches the maximum at this time. Continuing to increase peat amount, the permeability coefficient increases, because there is a large amount of peat in the soil. Water destroys the original pore structure of the flat bed, which makes the permeability coefficient increase and the water content increase. In conclusion, the addition of peat in sandy soil greatly improves its physical structure, making it more conducive to crop growth.

Table 1. Effects of Peat Addition on Physical and Chemical Properties of Turf Bed Matrix

| Handle   | Bulk density (g/cm³) | Permeability coefficient (10⁻² cm/s) | Total porosity (%) | Capillary porosity (%) | Non-capillary porosity (%) | pH  |
|----------|---------------------|-----------------------------------|--------------------|------------------------|---------------------------|-----|
| Contrast | 1.54                | 1.23                              | 40.38              | 14.23                  | 26.15                      | 6.78|
| 5% peat  | 1.51                | 0.97                              | 42.31              | 15.92                  | 26.39                      | 6.36|
| 10% peat | 1.45                | 0.91                              | 44.22              | 17.04                  | 27.18                      | 5.84|
| 15% peat | 1.41                | 0.82                              | 45.25              | 19.43                  | 25.82                      | 5.22|
| 20% peat | 1.35                | 0.73                              | 46.99              | 23.04                  | 23.95                      | 5.08|
| 25% peat | 1.31                | 0.55                              | 48.49              | 25.23                  | 23.26                      | 5.02|
| 30% peat | 1.24                | 0.96                              | 49.74              | 28.19                  | 21.55                      | 4.85|

2.2. Effects of Nutrient Elements on Soil
Rich in organic matter and a certain amount of nitrogen, phosphorus and potassium nutrients in peat which can provide a large number of nutrient elements for the soil, especially the peat itself carries rich humic acid, which greatly promotes the formation of soil aggregate structure and has a significant role in improving soil properties.

The total nitrogen content in peat is generally high in China, averaging 1.5%, which is about 40 times of the total nitrogen content in soil. The higher nitrogen content in peat is released by the organic residues of plants in the long-term decomposition, mainly ammonia nitrogen and nitrate nitrogen that plants can absorb directly [4]. Therefore, in the absence of total nitrogen content of soil, consider the addition of appropriate amount of peat [5]. Amino acid is also a nutrient component that can not be ignored in peat. It was found that there are 22 kinds of amino acid in peat. The content of amino acid in low-grade peat is the most, and the content of total nitrogen in peat is positively correlated with the content of amino acid [6-7].

2.3. Rehabilitation of Heavy Metal Contaminated Soil
Heavy metal pollution in farmland soil is very serious. Because of its long duration of pollution, it is not easy to be decomposed by other substances. Because of the concealment and irreversibility of pollution, it can be transmitted to human body through the food chain and directly endanger human health. Therefore, remediation of heavy metal pollution in soil has been the focus and hot spot of research for many years [8]. The larger specific surface area of peat makes it more capable of adsorbing and chelating. The existing humic acid can enhance the activity of oxidase in plant and stimulate plant growth [9]. It can accelerate plant growth, adsorb heavy metals well and reduce the damage of heavy metals to plants. Therefore, it is a good plant soil amendment.

3. The Role of Peat in Fertilizer Application
As a fertilizer, peat has become a mature technology in the world. At present, there are five types of fertilizer[10-11]: ①peat commercial organic fertilizer; ②peat organic-inorganic compound fertilizer; ③peat trace element compound fertilizer; ④peat biological active organic fertilizer; ⑤peat spraying fertilizer and flushing fertilizer. The first three kinds of humic acid fertilizers are also called humic acid fertilizers because of their high humic acid content [12].
4. Application of Peat Resources in Horticulture

Peat has easily obtain, which mainly be used in horticulture to prepare nutrient soil, nutrient bowl, seedbed soil and fibrous and powdery, granular commercial peat [13]. In some developed countries, the collection, processing and industrial production of peat have been completed on the basis of mature scientific theory, and the technological process has been completed, which can produce new products with high standards, such as peat nutrition bowl and lawn. Although peat production started late in China, it has also formed a simple large-scale production, which is widely used in the cultivation of flowers, vegetables and so on. The technological process can be summarized as follows: crushing, screening, pulping, drying, packaging, and finally forming a peat nutrition bowl. In the process of industrialized preparation of peat nutrient bowl, a series of complex and tedious labor such as matrix configuration, acidity regulation, and nutrient balance, insect repellent and so on were solidified in the seedling matrix, which improved the comprehensive utilization efficiency of users. Peat can also be produced as peat nutrient soil [14]. In recent years, it has been widely used in urban greening construction, flower nursery nutrient soil, desert greening, soilless cultivation, aseptic cultivation and so on. In the process of urban plant greening, it is of great significance to the construction of ecological city [15]. Peat nutrient soil can prevent pests and diseases, and has the advantages of small area, no need to change the cultivation medium frequently, simple operation, etc [16].

5. Suggestions on research and development of peat for agricultural soil improvement

(1) In modern agriculture, the problems of soil fertility decline, environmental pollution and crop quality decline caused by unbalanced fertilization and excessive chemical fertilization are becoming more and more serious. In terms of improved properties, bio-chemical method - "bio-fermentation tower" can be used to enhance the transformation of organic matter, so that the ratio of C and N elements in peat can reach the optimum ratio.

(2) Peat and its humic acid products are also useful ways of development. The development of peat products can be divided into five types: power fuel type, agricultural utilization type, chemical technology type, medical type and environmental protection type [17]. While adapting to the market demand, it is also an important direction for the development of peat enterprises in China to find products of different grades suitable for various regions, give full play to the coordinated development of raw material processing in-situ and deep processing in economically developed or demanding regions, and jointly develop and produce mutually complementary and mutually beneficial products.

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