Study on the Accumulation of Dry Matter and NPK Nutrients of Moringa Oleifera

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Abstract. In order to investigate the accumulation of dry matter and NPK nutrients in *Moringa oleifera*, the whole plant mastication method was used to study the dynamic changes in the dry matter and nutrition accumulati0ns of whole plants and organs (root, stem, leaf and fruit pod) at different times after planting of annual saplings. The results showed that the annual dry matter and NPK accumulation of *Moringa oleifera* saplings were 2.29 kg/plant, 27.05 g/plant, 8.64 g/plant and 60.46 g/plant, respectively, and the nutrient accumulation and nutrient accumulation were: potassium> Nitrogen > phosphorus. The accumulation of *Moringa oleifera* dry matter and NPK nutrients were divided into the cumulative slow phase before 100 days of colonization, the cumulative acceleration phase from 100 days after planting to pre-flowering and the rapid accumulation stage of flowering to fruit pod maturity. And the dry matter and NPK nutrient accumulations mainly distributed in roots and stems, but leaf dry matter and NPK nutrient accumulation are not high. During the ripening of the fruit pods, the dry matter of the pods and the NPK nutrients accumulate rapidly. Therefore, in the production of *Moringa oleifera*, the application of nitrogen and potassium fertilizers should deserves attention, and it is necessary to carry out cultivation management according to different needs in order to obtain high-yield fruit pods or leaves.

Introduction

Moringa oleifera is a multi-purpose fast-growing tree. It has very high economic and ecological value [1-3]. At the same time, *Moringa oleifera* is widely cultivated in tropical and subtropical regions of Asia and Africa. It has strong resistance to stress, and is highly adaptable to soil conditions and rainfall. In recent years, as a source of health food, *Moringa oleifera* has gained extensive attention and development in China, and has established a certain scale of *Moringa oleifera* planting bases in Hainan, Guangdong, Yunnan, Guangxi and other provinces [4-5]. At present, the research on *Moringa oleifera* in China and abroad mainly focuses on the value of nutrition and medicinal, and the development and utilization of active ingredients, but there are few researches on the cultivation and management techniques of *Moringa oleifera*. At present, there is a lack of scientific and effective cultivation management technology of *Moringa oleifera* plantation in China and abroad. Fertilization is one of the important contents of the artificial forest cultivation technology system, and the dry matter and NPK accumulation of plants are the basis and basis of scientific fertilization. At present, the fertilization *on Moringa oleifera* mainly focuses by planters' experience, and the researches concentrates on seedling stage research, which has less reference value for its production [4-6]. Based on this, the experiment was carried out at different times in the annual growth period of *Moringa oleifera*, and the dynamic changes of dry matter and NPK nutrients in different organs at different times were determined, to provide a theoretical basis for scientific fertilization.

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Materials and Methods

Materials.

This test was carried out in the base of Tropical Fruit Improvement Center in Dan zhou. The test soil was brick red soil. The basic soil properties were: bulk density 1.34 g/cm^3, pH 5.16, conductivity 35.89 μs/cm, organic matter 8.74 g/kg, total nitrogen 0.768 g/kg, available nitrogen (ammonium nitrogen and nitrate) State nitrogen) 157.22 mg / kg; available phosphorus 7.32 mg / kg; available potassium 90.83 mg / kg.The *Moringa oleifera* wood variety tested was Indian *Moringa*. The test site was planted in single and double rows with a planting size of 2.0 m × 2.0 m, and the test planting area was 0.07 hm^2.

Test Methods.

The experiment began in March 2016, and 10 days after the planting of Moringa oleifera, the tested samples were harvested every 45 days, and three healthy and representative plants with good growth were selected each time. Taking its root as the center, the whole plant was excavated within a circle with a radius of 45 cm, and four parts such as roots, stems, leaves and pods were measured for sampling. After washing by deionized water for 2 times, the collected Moringa oleifera. samples every time were used by the electronic balance (accurate to 0.01 g) to call the fresh weight of each part of the organs. And take a sub-sample (not less than 300g per sample), weigh, and then bake to constant weight at 75 ° C, weigh its dry weight.The above dry weight samples were pulverized and placed in a sealed bag for determination of nutrients such as NPK. After the sample was digested with H2SO4-H2O2, the nitrogen was determined by indophenol blue colorimetric [7], phosphorus was determined by molybdenum antimony colorimetric method [7], and potassium was analyzed by flame photometer [7].

Data Processing and Processing.

The test data were analyzed by Excel 2007 and SPSS 13.0 software for data processing and statistical analysis [8].

Results and Analysis

Dynamic Changes of Dry Matter Accumulation in Various Organs of *Moringa Oleifera.*

It could be seen from Figure 1 that the cumulative amount of dry matter of the whole plant of the sensation of the fruit pod was 2.29 kg/plant. Further analysis showed that the accumulation of dry matter in the whole plant can be divided into three stages. The first stage was100 days after planting (the first to third sampling), and the accumulation of its dry matter was slow. The second stage was from 100 days after planting to before flowering (the fourth and fifth sampling), and the accumulation rate of its dry matter increases. The third stage was flowering to fruit pod maturity (the sixth and seventh sampling) , the quality of its dry matter in this stage increased rapidly, which may be related to the large growth of stems and leaves and fruit enlargement at this stage. The dry matter accumulations in its three stages respectively accounted for 6.77%, 27.13% and 66.10%.

Figure 1 also showed that from the planting to flowering of *Moringa oleifera*, the organs which had the highest dry matter quality was root, followed by stems and leaves. During the flowering to the ripening of the fruit pods, the accumulation of dry matter in various organs changed significantly. In the early stage of the fruit pod, the stem mass was the highest, followed by the root, and the dry weight of the pod was the least. The fruit pod dry mass was significantly increased when harvested, the dry matter quality of each organ from large to small in order: stem, roo, leaf, fruit pod. It can be seen that the dry matter accumulation of the fruit pods was rapid, and the accumulated dry matter mass at this stage accounts for 14.63% of the whole plant when harvested. It can be seen that under the condition of no- controlled height, the accumulation of dry matter is mainly distributed in the root and stem, and the leaf are less.

Dynamic Changes of NPK Nutrient Accumulation in Various Organs of *Moringa Oleifera.*

The results in Figure 2 showed that the cumulative N accumulation of *Moringa oleifera* increased with its growth, and the cumulative N accumulation of the whole plant at harvest was 27.08 g/plant. N accumulation was the same as dry matter, which is divided into the same three

stages. The N accumulations in its three stages respectively accounted for 7.21%, 16.45% and 76.34%. It could be seen that it is necessary to focus on the rational supplementation of nitrogen fertilizer during flowering to ripening of the fruit pod. The N accumulation in root was the highest organs from the planting to flowering of *Moringa oleifera*, followed by that of stem and leaf. During the flowering to the ripening of the fruit pods, the N accumulation in its various organs changed significantly. In the early stage of the geranium pod, the N accumulation of stem was the highest. Further analysis showed that the N accumulation of fruit pods during fruit pod development was rapid, and the cumulative amount at this stage accounted for 31.75% of the total plant N accumulation. It can be seen that root and stem are the main organs of N accumulation before the flowering. The fertilization at this stage is beneficial to the rapid growth and cultivation of robust plants. The application of nitrogen fertilizer after flowering is beneficial to the growth of pods and leaves. .

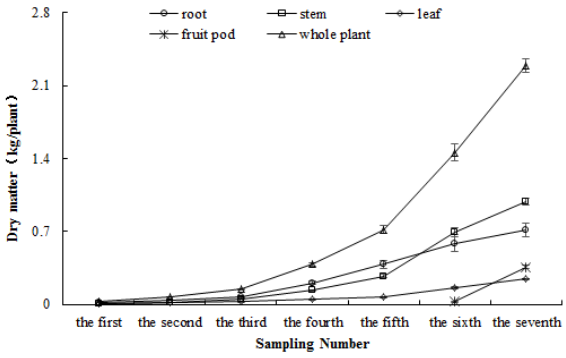

Fig. 1 The N accumulation amount t of dry matter in various organs of *Moringa oleifera* at different growth times

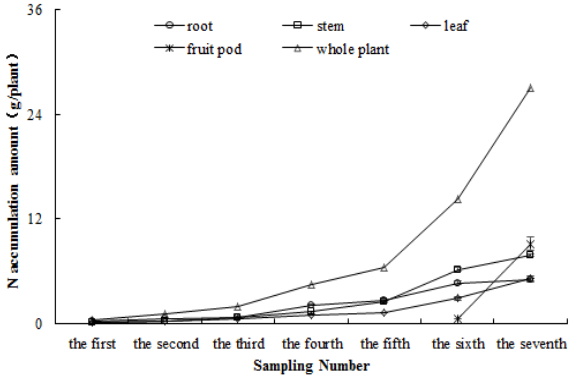

Fig. 2 The N accumulation amount in various organs of *Moringa oleifera* at different growth times

The P cumulative amount of *Moringa oleifera* increased with its growth in the whole plant, and the cumulative amount of P in the whole plant at harvest was 8.64 g/plant (Figure3). Similar to N accumulation, P accumulation was also divided into three stages. The three stage were 100 days after planting, from 100 days after planting to before flowering, from flowering to fruit pod maturity. The Paccumulations in its three stages respectively accounted for 4.88%, 20.17% and 75.11%.It could be seen that in the process of *Moringa oleifera* planting, it is also necessary to focus on the rational supplementation of phosphate fertilizer during the period from 100 days after planting to the ripening of the fruit pod. The P accumulation amount in root was the highest among its three organs (root, stem and leaf) before 100 days after planting, followed by P accumulation amount of leaf and stem. From the 100th day after planting to the early stage of fruit pod maturity, the order of P accumulation in various organs of *Moringa oleifera* was stem, root, leaf. When the pod matured, the order showed: stem>root, leaf>fruit pod.

It could be seen from Figure 4 that the cumulative K accumulation of the whole plant is 60.46 g/plant at harvest, and also was divided into three same stages. The cumulative amount of K in the above three stages accounted for 7.93%, 23.73% and 68.34% of the total plant accumulation at the time of harvest, respectively. The potassium fertilizer should be applied in the process of flowering to fruit pod harvesting. At the same time, from the planting to flowering of *Moringa oleifera*, the order of K accumulation in various organs was root>stem>leaf, and the initial stage of fruit pod was: stem>root>leaf>fruit pod, and when the fruit pod matured, it showed: stem >root>fruit pod>leaf. With the continuous growth of *Moringa oleifera* pods, the K cumulative amount of fruit pods increased, and the cumulative amount increased by 18.72% of the total plant accumulation at harvest. It can be seen that root and stem are the main cumulative organs of K during the growth of *Moringa oleifera* ,and the fruit is the main cumulative organ of K during the growth of fruit pods.

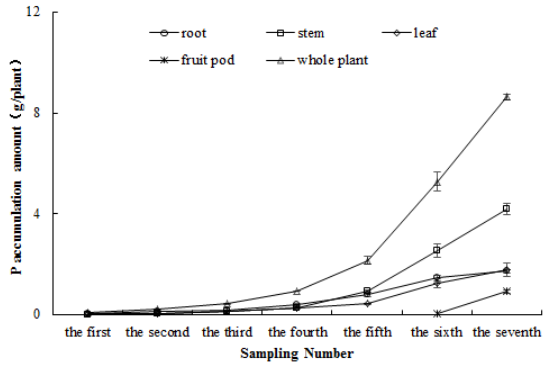

Figure. 3 The P accumulation amount in various organs of *Moringa oleifera* at different growth times

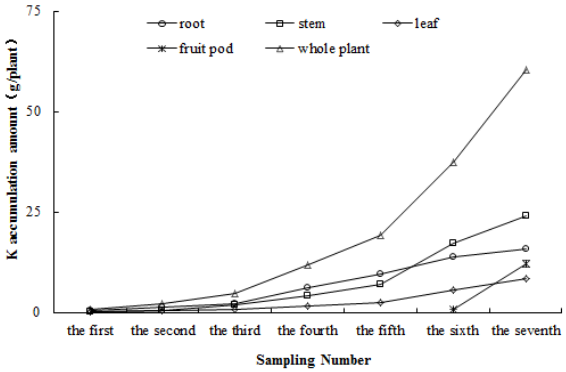

Figure. 4 The K accumulation amount in various organs of *Moringa oleifera*.at different growth times

Discussion

Moringa oleifera is a plant homologous to medicines and foods, and its seed oil is a kind of unsaturated fatty acid-rich soil extremely beneficial for human health [9-10]. Therefore, *Moringa oleifera* has unique nutritional value, medicinal value and superior ecological adaptability. Its development in Chinese tropical area has a good market and commercial prospects [11]. In recent years, Chinese scholars have done a lot of research on the introduction, application and resource development and utilization of *Moringa oleifera*. With its values were fully understood in China, *Moringa oleifera* planting, especially scientific planting, has become one of the important bottlenecks in its development in China. In this study, the accumulation of dry matter and NPK nutrients in annual *Moringa oleifera* planting respectively increased with the growth time. When the fruit pods were matured, the dry matter and NPK nutrient accumulation were 2.29 kg/plant, 27.05 g/plant, 8.64 g/plant and 60.46 g/plant, respectively. The order of nutrient accumulation was as follows: potassium > nitrogen > phosphorus. The nutrient accumulation rule and nutrient accumulation order result are the same as the previous research results [4-5]. Therefore, the rational application of a sufficient amount of NPK fertilizer has an important role in the high yield of *Moringa oleifera*, and should the application of nitrogen and potassium fertilizer should be emphasized in its production. How to achieve the nutrient characteristics of *Moringa oleifera's* NPK nutrient, combing the fertilizer utilization rate of suitable planting area, will be the key to the its cultivation, and it is also the key problem that needs to be solved in its high-efficiency cultivation. In addition, the *Moringa oleifera* studied in this experiment was from the colonization to the whole growth stage of the first result pod, and the results showed that the dry matter and NPK nutrient accumulation were mainly distributed in root and stem, while dry matter and NPK nutrients accumulations in the commercial value of leaf were not high.

Acknowledgement

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