Analysis of the influence of the characteristics of mountain soil and the noise in the tunnel on people: active noise control system

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Abstract

The production area of a mountain crop includes the resources of the land, the water, and heat coefficient, and the advantages of light and temperature are very obvious. These crops are fully developed in planting, and the pigment formation is very good, and the sugar content is high, and the damage degree of pests, and diseases are also relatively high. low. According to experts at home and abroad, this is the best planting area in the world for planting and cultivation. In this paper, a large number of samples have been collected for research and experiments, and the physical and chemical properties and biological properties of local species in a certain mountainous area have been analyzed. The growth and development of crop quality factors in the soil and the formation of products are systematically studied. After the establishment of a perfect soil quality evaluation system, it provides guidance and realistic theoretical basis for local crop industry growers. It needs to be calibrated before each data collection, especially for all sensors inside and outside the main tunnel, to ensure the accuracy and feasibility of the tunnel test in the test. The calibration of the sensor includes its sensitivity and the calibration of the sensitivity at the factory. As time goes by, its temperature, dust, and humidity will have a certain influence, which will cause its sensitivity to change. Acquired acoustic signals will also cause inaccurate results along with inaccurate sensitivity and finally in the tunnel will also affect the results of inaccurate noise distribution. This experiment uses the PAI sound and vibration test analysis system in the table for data collection. The acquisition process is to obtain the analog degree of different devices on different sensors and the information of the tested unit and finally make the digital information obtain representative physical meaning.

Keywords Mountain soil characteristics · Mountain tunnels · Noise interference · Active control

Introduction

Through the analysis and research on the soil indicators and different soil levels of a typical mountain crop garden in different planting years, it is found that (1) the geology of the soil in a mountain area is relatively coarse, and the content of sand is more than 60% and it is buried in the soil. Under the influence of vines, the difference between the inner and outer layers is not particularly significant. The 2m alluvial wood characteristics are more obvious, and the degree of soil development is not high, and it is relatively poor within a certain range (Felicisimo et al. 2012). (2) The specific content of the soil is less. With the increase of the year, the soil of the garden planted is > 0.36mm, and the water stability characteristics are also more obvious (Friedman et al. 2000). (3) The capacity of the soil in each vegetation garden is relatively large, which exceeds the limit and inhibits the growth and development of roots to a large extent (Golkarian et al. 2018). (4) In the surface and subsurface parts of the soil, the main air pores and capillary pores are the main ones, and the subsurface layer is dominated by the capillary pores. Each bottom layer is dominated by inactive pores. Although the performance of the soil is better, the leakage of water and fertilizer is more serious (Hamdan and Khozyem 2018). (5) The water holding capacity of the bottom of the soil in the field is relatively high. Although its surface water content is the highest, its coefficient of variation in the field is large, so the coefficient of variation of saturated water content is relatively small. Even
though the degree of water content in soil changes rapidly, the water holding capacity is poor (Hamdan and Khozyem 2018).

(6) The 100 acres of the promenade in a mountainous area are divided in detail according to the area. The study found that the sand performance of the mountainous area of the promenade is relatively strong. If the sandy soil is mainly gravel, it is not conducive to the development of the root system of the crop; the soil in the production area a is too sticky and heavy; the soil in the b area is mainly made of light soil and windy sand; the c and d areas are mainly sandy loam, although the aeration is good, and the soil structure is not conducive to stability (Issawi and Anonymous 1978). The median algorithm can effectively separate and reduce the noise of the signal with impact noise, but it cannot solve the problem of this algorithm because the fixed factor value cannot quickly and take into account the shortcomings of convergence speed and steady-state error. Therefore, the LMS algorithm proposed in this paper is a variable step algorithm, which can actively control the noise problem in the car (Khidr 1997). If the degree of active control of the noise in the car is obvious, then the algorithm research problem proposed in the article overcomes its own shortcomings, which is an effective method of noise control in the car (Kim et al. 2019).

Research design

Mountain soil sampling and experimental methods

**Determination of soil physical properties**

Soil bulk density: A ring knife method is used. The knife is inserted into the soil vertically in every aspect, and then the surrounding part of the soil is excavated with a shovel, and the other excess soil is cut away with a knife. The temperature is 115°C. To bake the box, then use tweezers to pick it up and place it on the balance to weigh (Klitzsch et al. 1987).

Soil moisture content: Measured by specific immersion method.

Soil field water holding capacity: Measured by the ring knife method (Lee 2005).

The composition of soil mechanical problems: The dry sieving method is used for preliminary determination, and the wet sieving method is used to stabilize the aggregate performance.

Soil pores: Calculated and converted by infiltration method (Lee et al. 2004).

Soil aggregates: The wet sieving method adopted by the preliminary dry sieving method was used to establish water-stable aggregates.

The distribution of meteorological stations in a mountainous area is shown in Fig. 1:

**Determination of soil chemical properties**

pH: Use the potentiometric method with a pH meter (water: soil = 5:1).

Full salt: Measured with DDS-11 conductivity meter.

Organic matter: Use potassium dichromate and ferrous sulfate for titration test.

Total nitrogen: Using the distillation method, the sodium hydroxide of total phosphorus is anti-antimony and anti-color problems.

Alkaline hydrolysis of nitrogen: Alkaline hydrolysis and diffusion method.

Quick-acting potassium: Flame photometric method using ammonium acetate to soak the embankment.

The effective calcium and magnesium are all measured by the atom in the process of absorbing light. The wave length is 527.3nm. The effective iron, manganese, copper, and zinc are all measured by atomic absorption method, and the content of metal elements in the solution was determined directly by atomic spectrometry.

The principle and collection method of noise in the tunnel

Before collecting data each time, a sensor calibration test is required to ensure the accuracy of the test results in the tunnel experiment. The so-called sensor calibration refers to the sensitivity calibration of all sensors in the tunnel and the sensitivity calibration of each sensor when it leaves the factory (Liu et al. 2016). But as time changes, the temperature, humidity, and dust level of the sensor will be affected, which in turn affects its sensitivity. However, inaccurate sensitivity will lead to inaccuracy of the collected acoustic signal results and ultimately affect the inaccuracy of tunnel noise distribution results. In this experiment, the PAI sound and vibration test and analysis system in the table were used for data collection (Malekzadeh et al. 2019). The purpose of the data collection system is to obtain the simulation of various sensors and other equipment and the information collection of the test digital and the unit under test and then process each collected information and obtain the meaning of the signal. Finally, analysis and research are carried out (Mirzaei et al. 2020).

In each case of data acquisition and analysis, the system is composed of the software and hardware equipment of the front part of each segment and the software data of the back part for analysis and processing. The data collection of each front part will be from the measuring point, starting from a certain part of the sensor, and then the measurement methods of different physical quantities were studied. Each time the information received by the sensor will be converted into an analog electrical signal output according to a certain rule (Moawad 2013). The sensor and the analog-to-digital conversion device are connected by wires, and then use the wires to

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output the signal to the analog-to-digital device, and then the analog signal is converted into a digital signal that the computer can recognize. Each analog-to-digital conversion device is connected with the computer through a dedicated device, and the calculation is performed using data acquisition software. In the process of data collection, by reading the data and storing it in the hard disk or other computer-connected equipment, each equipment needs power supply (Moawad et al. 2016). Due to the restrictions on the conditions of the tunnel, each laboratory needs to carry out its own power distribution. The equipment that generates electricity is then supplied on site. The above is the whole process of field data collection and storage. According to the collection process, we can know that it is mainly composed of power supply, data transmission, and sensor transmission equipment and module conversion, computer and other software (Moore and Grayson 1991). In general, the tunnel is relatively long, and the length is greater than the width and its height to a certain extent, and the interior of the tunnel is relatively smooth. At the same time, the long space tunnel can be regarded as a uniformly finite long tube. The incident wave and reflected wave are in the form of Eqs. (1) and (2):

\[ P_i = p_a e^{i(\omega t - kx)} \]  

\[ P_r = p_a e^{i(\omega t + kx)} \]  

The reflection wave port is caused by the acoustic load, it is different from the incident wave, and there is also a phase difference, which can generally be expressed as Eq. (3):

\[ \frac{P_r}{P_i} = |p_a| e^{i\sigma} \]  

Formula 1 and 2 are added together to calculate the total sound pressure, as Formula 4:

\[ p = p_i + p_r = p_a e^{i(kx + \sigma)} \]

\[ p_a = |p_a| e^{i(\omega t + \psi)} \]  

Among them:

\[ |p_a| = p_a \sqrt{1 + \left(1 + 2 \frac{r_p}{c_0} \frac{\sigma}{\lambda} \right)^2 - 2 \frac{r_p}{c_0} \frac{\sigma}{\lambda} \frac{x}{\lambda}} \]  

The three-dimensional coordinate wave equation is Eq. (6):

\[ \frac{\partial^2 p}{\partial x^2} + \frac{\partial^2 p}{\partial y^2} + \frac{\partial^2 p}{\partial z^2} = \frac{1}{c^2} \frac{\partial^2 p}{\partial t^2} \]  

According to the relationship between the two coordinates of the right angle and the cylinder, we can get the equation of the cylinder coordinate as Eq. (7):

\[ \frac{1}{r} \frac{\partial}{\partial r} \left( r \frac{\partial p}{\partial r} \right) + \frac{1}{r^2} \frac{\partial^2 p}{\partial \theta^2} + \frac{1}{c^2} \frac{\partial^2 p}{\partial t^2} = \frac{1}{c^2} \frac{\partial^2 p}{\partial t^2} \]  

According to this equation, the sound pressure in the tube can be obtained as Eq. (8):

\[ p_m = A_m J_m(k_m r) \cos(m \theta - \phi_m) e^{i(\omega t - k_m z)} \]  

**Design of active noise control system**

**Median LMS algorithm structure parameter setting**

This paper uses the median algorithm to simulate the active control simulation technology of its track vehicle noise control. This algorithm takes the discrete error signal over a period of time for research and updates the adaptive filter weights. Then the error signal is directly used in the update application of the filter, and the weight vector formula of the filter is as follows: (9) and (10):

\[ W(n + 1) = W(n) + \mu \cdot \text{med} \left\{ e(n) X(n), e(n-1) X(n-1), \ldots, e(n-1 + 1) X(n-1 + 1) \right\} \]  

\[ W(n) \]  

\[ \mu \]
Variable step size LMS algorithm structure parameter setting

This paper uses the variable step algorithm of sine function to study the function relationship between each factor, and error signal is as follows:

\[ \mu(n) = \beta |\sin(a|e(n)|-\pi/2)| + 1 \]  \hspace{1cm} (11)

The two dependent variables in the formula are the structural parameters of the variable step size algorithm. The step size function controlled by each different parameter is within a certain value range, which will not only affect the convergence speed of each but also affect each parameter; the shape of the step length curve is close to zero in the steady state. When the factor is fixed, the functional relationship between each step length and the error signal is shown in Fig. 2. When the parameters are fixed, the function relationship between the step length and the error signal is shown in Fig. 3 (Naghibi and Moradi Dashtpagerdi 2016). For each same initial error, the larger the parameter, the faster the convergence speed in the initial stage. The convergence speed of the algorithm increases and the corresponding n value may be larger. If the steady-state error has a relatively high requirement, then you should select a relatively small parameter value. If you want to obtain a faster convergence and tracking speed, you should increase the number of parameters, and if you want to get a relatively small steady-state error, you should decrease the parameter value. But as the number of selections of the two parameter values becomes smaller, the algorithm of variable step size will regress to another algorithm.

Similarly, it can be seen from Fig. 3 that when \( \beta \) is fixed, if there is a higher requirement for the convergence speed of the algorithm, then a larger parameter value should be selected; if there is a higher requirement for a stable error, the parameter value should be selected smaller. Yes, the smaller the parameter value is selected, the smaller the interval of change in the process of algorithm convergence. Figures 2 and 3 show that in the initial convergence stage, the larger the value of n, the larger the corresponding \( \mu(n) \) value, and the faster the algorithm converges (Natarajan and Sudheer 2019). When the algorithm enters the convergent state, the value of \( |e(n)| \) reaches the minimum, and the corresponding \( \mu(n) \) value is also the minimum. Therefore, compared with the LMS algorithm, the algorithm used in this article can solve its inherent defects or is an effective improvement algorithm. In terms of parameter selection, this article adopts two measures, fixed value and optimized value (Nourani et al. 2014). The range of values and the adoption of the algorithm and the optimization results are shown in Fig. 4:

As shown in Fig. 4, the optimal values of the two parameters are 1, respectively, but the selection of the optimal values of the two parameters may currently require lack of theoretical data, and it can only be determined and developed through experiments. The article also gives there are two parameter adjustment principles: if you want to obtain a faster convergence and tracking speed, you should increase the number of parameters, and if you want to get a relatively small steady-state error, you should decrease the parameter value. But as the number of selections of the two parameter values becomes smaller, the algorithm of variable step size will regress to another algorithm.

Fig. 2 \( \mu(n) \) and \( e(n) \) relationship curve (a is fixed)
Experimental results

Analysis of the characteristics of mountain soil

Measurement results of soil physical properties

It can be seen from Table 1 that the soil planting area of a mountain crop is mainly sand grains, followed by silt and clay particles. The study found that the texture changes between different layers are also different. If the soil layer is deeper, the less sand content is, and the clay particles will increase instead. The soil powder content of the bottom layer is obviously higher than that of the other two layers (Pakparvar et al. 2018). For a certain mountain crop, the range of the sand content of the soil to remove the surface layer is between 50 and 70%, the range of the change of powder grain is between 15 and 30%, and the range of the change of clay grain line is between 20 and 40%. As the depth of the soil increases, the sand content becomes less and less; otherwise, the clay particles increase, and the silt content at the bottom of the soil is significantly higher than the other two parts, and the coefficients of each different layer are also constant (Paraskevas et al. 2015). The types in soil vary greatly, too.

It can be seen from Table 2 that the overall row aggregates of the plantation soil of a certain mountain crop are relatively low, and the content of soil stable aggregates with a diameter of 0.35–0.6mm is relatively large, and the dominance is also smaller than that of other soils. The content of soil water-stable aggregates within 50cm is higher than that of the bottom soil. From the perspective of the percentage of soil aggregates of each level, the proportions of >6mm are 43.54%, 62.71%, and 6–2mm. The proportions of 2-1mm and other grades are 6.02%, 7.06%, and 4.28%, respectively. The aggregate content of the surface layer is equivalent to relatively high, and the content of the soil aggregates in the upper layer is the largest, exceeding 70%. The dispersed state of the soil particles basically exists, and the stability and erosion resistance of the soil are relatively weak.

Table 3 shows that the soil content of a crop plantation in a certain mountainous area is relatively large, and the scope of change is also limited. The surface soil content is not more than 2g. If the soil is loose, then it is suitable for cultivation in some environment suitable for the growth of crop roots. The deeper the degree, the greater the internal soil capacity. When the soil layer reaches a certain value, the area of each part is as high as 1.73g per cubic centimeter. If the volume is too large, it will inhibit the degree of deep penetration and growth of the root system. From the coefficient of each variation, it can be known that the soil content in the study area will become higher overall, ranging from 8.3 to 14.6%. The minimum value of soil capacity is 2.06g, and the maximum value is 3.68g, which indicates the surface layer. The difference between the two layers of the subsurface layer is not obvious, and both are lower than the soil value of the bottom layer.

The terrain features of a certain mountainous area are complex and diverse. According to the comparative standard of Chinese geomorphological mapping that can be seen from the research, this terrain is divided into 5 grades, namely, flat, slightly undulating, small and medium undulating, and large undulating. A certain mountainous terrain is dominated by small undulations (70–200m), accounting for 62.87%; slightly undulating (30–70m) terrain, accounting for 17.59%; and moderately undulating terrain (200–500m) accounting for 11.51%, mainly distributed on the western edge in the northeast and northwest part of Shaanxi; the flat area accounts for 8.56%. It is concentrated in the eastern part of a mountainous
Fig. 4  Error signal curve under different parameters
area and the Hanzhong area and is distributed in fragments in northern Gansu; large ups and downs (≥500m) account for a small proportion (0.07%) and are mainly distributed in the main ridge of each mountain range and the southwest corner of a mountain, as shown in Fig. 5:

The roughness of the surface refers to the ratio of the surface area of the earth to its projected area in each specific area, which reflects an index degree of the surface morphology. The roughness of each soil surface refers to an important part of the characteristics of soil hydrology. The roughness of the surface has a certain effect on soil invasion, and it also has two effects in the process of erosion, namely, enhancement and reduction, which can change the physical and chemical properties of the soil to a certain extent and the nature of runoff. In rain types such as reducing the shear force of runoff, the duration of the rainfall will indirectly affect the occurrence process and the rate of erosion, as shown in Fig. 6.

**Results of determination of soil chemical properties**

Soil organic matter is the most important source of nutrients in the soil. It can not only improve the physical structure of the soil but also promote the growth and development of plant roots. If the activity of microorganisms is increased, it will improve the fertility and buffering capacity of the soil to a certain extent and has the function of activating mineral elements. The content characteristics and distribution frequency of organic matter in the soil in the cultivation area of a certain mountain crop are shown in Fig. 7. The smaller the average value of the range, the smaller the average value of the range, which means that the growers of the crops attach great importance to and improve the organic level of the soil. Adding organic fertilizer will increase the level of organic matter in the soil. Figure 7 can clearly reflect the overall distribution of organic matter in the plantation. The overall distribution of organic matter in the soil is on the left, with a frequency of 3.65 kg, indicating that the level of fertility is relatively low. Need to add a lot of organic matter.

The nitrogen content in the soil is affected by various factors such as the input of nitrogen fertilizer, the fertility of the soil and the absorption of nitrogen by crops. Table 4 shows that the total nitrogen content in the absorption root distribution area of surface crops is the lowest. The content is different; there is a big difference. If the nitrogen content in the early stage is limited and the nitrogen supply capacity is relatively weak, then the nitrogen consumption in the later stage will be higher, and the artificial nitrogen content in each year can be kept at the same level as the content consumed each time. The difference in the total nitrogen content of vegetation in different years is not significant. For the entire vegetation as a whole, the total nitrogen content is not only low but also in the range of lacking grades. If you want to ensure the healthy development of crops, you need to follow a certain order supplement nitrogen fertilizer.

| Particle size | Soil layer (cm) | Mean | Max  | Minimum | Very bad | Variance | Standard deviation | Coefficient of Variation | 95% confidence interval |
|---------------|----------------|------|------|---------|----------|----------|-------------------|--------------------------|------------------------|
| Sand 0.02–2 mm| 0–20           | 59.89| 71.1 | 40.1    | 31       | 54.8     | 8.65              | 0.11                     | 54.89–64.34             |
|               | 20–40          | 58.39| 68.1 | 48.1    | 20       | 22.37    | 6.51              | 0.08                     | 54.63–62.17             |
|               | 40–60          | 32.69| 57.1 | 23.2    | 23.9     | 27.28    | 6.88              | 0.13                     | 28.73–40.19             |
|               | 0–20           | 16.79| 52   | 11      | 21       | 52.1     | 0.77              | 27.1                     | 13.78–33.24             |
| Powder 0.002–0.02 mm| 20–40 | 15.86| 23   | 12      | 11       | 9.98     | 3.16              | 0.54                     | 14.08–20.18             |
|               | 40–60          | 19.54| 26   | 16.5    | 9.5      | 7.29     | 2.7               | 0.28                     | 17.07–20.96             |
| Clay <0.002 mm| 0–20           | 23.33| 31.9 | 11.9    | 20       | 19.36    | 4.47              | 0.34                     | 20.75–25.58             |
|               | 40–60          | 25.76| 31.9 | 18.9    | 13       | 20.13    | 4.49              | 0.28                     | 23.11–28.69             |

Table 2: Variation characteristics of soil aggregates in a mountain crop plantation (%) (606 samples)
The soil content in this area is mainly composed of the local phosphorus-rich limestone, which is affected by the parent soil. The management of the soil after cultivation has a relatively small impact on the total phosphorus. If the plant roots in the soil can absorb the available phosphorus component, then the part can be fixed. Therefore, the longer the planting time of the vegetation, the higher the total phosphorus content. It can be seen from Table 5 that the total phosphorus content of the surface soil with a planting period of 9 years has increased significantly, and the depth of crop planting has no significant difference in total phosphorus in different soils. With the increase in the number of years, the phosphorus content has increased but not obvious; the highest soil content of the vegetation garden within 3 years of planting is only 8.06 mg, which is significantly lower than that of the vegetation gardens of 6 and 9 years. Fertilization can supplement a large amount of phosphorus content to a certain extent, and the roots also consume a large amount of phosphorus. The input and consumption of the planting period of 6 years remained basically the same.

The potassium content in the soil changes with the nutrient absorption of surface plants. As shown in Table 6, as the planting time increases, the content of available potassium also increases. Vegetation plants belong to potassium-like plants. Crops need to increase the demand for potassium after the fruit expands. With the continuous supplement of fertilizer, the content of potassium in the soil is also increasing, but the content of the surface layer and the subsurface layer are also different, and the surface layer is significantly higher than that of the subsurface layer. There is no significant difference in soil available potassium for years.

**Analysis of noise signal in tunnel**

When all the vehicles on the track are moving, there may be a certain degree of noise problem in the car body and the noise reflected in the tunnel due to the narrow road, which makes the noise inside the car continue to increase, passing the outside of the car, projected into the car. The following figure shows the problem of measuring points in the car under three conditions of acceleration and uniform speed and deceleration of different vehicles on the track. At this time, in order to intuitively understand the characteristics of the noise of the measuring points under different working conditions of the tunnel, the curve is drawn.

It can be seen from Fig. 8 that the weights of the measuring points of the operating conditions in each tunnel are different, and the sound pressure levels are all above 85dB. The researcher analyzed the reasons, mainly because the joints of the cars are in a sealed state, the sound insulation effect and the sound absorption effect are not good, and it will also affect the noise problem in the cabin. Another reason is that the measurement points of different road conditions are different, and the scores are not equal. When each different train is running at a constant speed, the speed of the vehicle is answered to the maximum value during the operation of the vehicle. At this time, the acceleration and deceleration are

![Fig. 5 The undulation degree of a mountainous terrain](image)
relatively large and reach the highest value, so a relatively large noise problem will occur.

Frequency is one of the important parameters describing the characteristics of sound. This paper analyzes the octave frequency of noise at 8 measuring points in different positions under each different working condition, as shown in Figs. 9, 10, 11, and 12.

Analysis of the results of active noise control in the car

In this paper, when the selected measuring point 1 is on the elevated bridge and different vehicles are traveling at a constant speed, some of the cars will be perpendicular to the floor due to the height of 2.1m. The noise sample becomes the noise of the main control algorithm. Object, each different sample is set at a frequency of 31250Hz. It can be seen that the 5s intercepted in the figure is used as a main noise elimination object. Figures 13 and 14 are the waveforms of the original noise in time.

In the active noise control of the LMS algorithm, the sample selects the same measurement point 1, which is the situation when the vehicle on the track is driving at a constant speed. The height of the horizontal axis in the carriage on the upper part of the elevated bridge is 2.1. When m, the sampling frequency is set to 21105Hz. If 5s is intercepted as the main noise elimination object, the LMS algorithm and the variable step algorithm proposed in the article are used for the internal active control of rail vehicle noise. If it is based on the algorithm, the result of active noise reduction is shown in Fig. 14. The filter order of the variable step size algorithm has reached M=11, and the result of active noise reduction is shown in Fig. 14.

From the curve in the figure, it can be known that if the LMS algorithm is guaranteed to reach the condition of convergence, another algorithm will converge in each of the fastest conditions, that is, the 65th sampling point, but the curve is not smooth. Compared with the variable step size algorithm, the LMS algorithm proposed in this paper converges faster. The curve shows that the algorithm has entered
the overall convergence state at the 27th sampling point, and the convergence curve is very smooth. It can be seen from Figure 14 that the steady-state error of the variable step algorithm proposed in this paper is obviously smaller than that of the LMS algorithm. As the convergence of the algorithm becomes larger, the variable step algorithm will gradually increase in steady-state error. Changes with changes, that is, the algorithm is getting smaller. In the LMS algorithm, the error signal fluctuates greatly in the process of convergence. The steady-state error of each different error signal at the sampling point will gradually increase, and the error of the variable step algorithm will also be between the two. The time gradually grows larger.

Discussion

Discussion on the physical properties of mountain soil

The soil in the crop production area in a mountainous area is mainly lime-calcium, mainly including silt soil, windy sandy soil and gravelly sandy soil. The content of windy sand and lime-calcium soil in the soil layer area is relatively low, and the surface soil is sandy. More serious, the content of sand is higher than others, the clay content of the organic matter in the soil is low, and the capacity is relatively large. These conditions are not conducive to the development of vegetation roots, but there are some important advantages in the production of raw materials. The clay in the soil area is relatively high, the texture is mostly in the middle soil area, and the capacity is relatively low. The water holding capacity in the clay is relatively strong, and it is conducive to the growth and development of the root system, but there are no high-quality conditions for the production of high-quality crops. In addition to the instillation of silt soil, the soil in a mountainous area has a strong sand content. And more than 60%, the number of aggregates in this area is relatively small, especially the proportion of water-stable aggregates is relatively small. Planting and tillage are conducive to the formation of aggregate structure in this area, and the sandy soil content is larger than the others. The quality of each measured soil exceeds the average. In terms of fertilization, the depth of organic fertilization reduces the capacity at that time, and the aeration pores and capillary pores become the main cultivation layer. The number of active pores in the accumulation area is relatively high, and the removal of the calcium accumulation layer is

| Table 4 | Nitrogen content in soil with different planting years (108 samples) |
|---------|--------------------------------|
| Years   | Soil depth | Alkaline hydrolysis of nitrogen (mg·kg⁻¹) | Total nitrogen (g·kg⁻¹) |
| 2a      | 0–20 cm    | 11.35c                                      | 0.22b                    |
|         | 20–40 cm   | 11.26c                                      | 0.32ab                   |
|         | 40–60 cm   | 10.34d                                      | 0.36a                    |
| 5a      | 0–20 cm    | 14.46b                                      | 0.27b                    |
|         | 20–40 cm   | 14.31b                                      | 0.33ab                   |
|         | 40–60 cm   | 11.25c                                      | 0.35a                    |
| 8a      | 0–20 cm    | 16.35a                                      | 0.26b                    |
|         | 20–40 cm   | 14.39b                                      | 0.37a                    |
|         | 40–60 cm   | 12.20c                                      | 0.36a                    |
beneficial to the air exchange in the root area of the vegetation. The soil water retention performance in this area is relatively poor. The main types of distribution were upper and lower clay, the main saturated water content of soil layer was also relatively high, the water capacity of the lower part of the field was relatively low, the depth of the main planting root zone of crops was about 40 cm, and the spatial variation coefficient ratio of different soil physical properties content was higher. The deep furrow shallow planting method has broken all the problems of the straw and the surface layer in the soil and also improved the physical properties of the soil and improved an important foundation of the excellent planting garden.

**Discussion on the chemical properties of mountain soil**

A certain mountainous soil in a certain area is a kind of calcareous soil. The pH value exceeds 8.9 and belongs to alkaline soil. The highest alkaline can reach 9.51 strong alkaline, which can inhibit the normal growth and development of crop roots and some metal elements. The effective performance supply of some nutrients such as calcium, magnesium, manganese, copper, zinc, etc., restricted by the flooding landform and weak wind, the salt content in the soil has reached about 0.5kg, and all of them are chloride and sulfate. The main salt is not enough to bring growth damage to crops. The content of organic matter in the soil is relatively low and very scarce. The maximum content is less than the lowest level six, which is far from enough to meet the highest quality and stable production requirements. With the gradual increase in depth, the performance is continuously reduced, which seriously affects the growth of crops and the improvement and optimization effect on the soil, and it is necessary to increase the intensity of organic fertilizer cultivation. The content of total nitrogen and alkaline hydrolyzed nitrogen in the soil are appropriately supplemented with nitrogen fertilizer according to the requirements of the yield, but the effective phosphorus content is relatively low on the whole. Under alkaline conditions, the phenomenon of phosphorus fixation is also more serious and effective The intensity is relatively low. With the increase of planting years, it is necessary to supplement a certain amount of phosphorus and potassium in the soil, which is conducive to the development and metabolism of the root system. The content of available potassium in a mountainous soil is relatively low and unreasonable application will cause the nutrient ratio in the soil to be inconsistent. The effective calcium and magnesium content in a mountain botanical garden is relatively rich, and it has extremely high-quality crops as raw materials for planting. Although the content of some trace elements in the soil is relatively high, the effective performance is relatively poor. The content of water-soluble elements is generally relatively low, especially zinc and iron are the most lacking, which severely restricts the growth and development of crops. The construction of a personalized winery in a mountainous area in this area, and the requirements for high-quality vegetation wines determine that high yield is not the main pursuit goal. Therefore, the harmless treatment of straw is carried out through the fermentation of aerobic bacteria and anaerobic bacteria and then promotes the structure of the soil. The formation of soil and stability reduces the pH value of the soil, activates the nutrient elements in the soil,

| Table 5 | Phosphorus in the soil of plantations in different years (108 samples) |
|---------|-----------------|-----------------|-----------------|
| Years   | Soil depth      | Available phosphorus (mg·kg$^{-1}$) | Total phosphorus (g·kg$^{-1}$) |
| 2a      | 0–20 cm         | 8.93d           | 0.21b           |
|         | 20–40 cm        | 8.75d           | 0.24b           |
|         | 40–60 cm        | 9.02d           | 0.29b           |
| 5a      | 0–20 cm         | 24.29c          | 0.25b           |
|         | 20–40 cm        | 32.47b          | 0.25b           |
|         | 40–60 cm        | 20.54c          | 0.21b           |
| 8a      | 0–20 cm         | 29.97bc         | 0.39a           |
|         | 20–40 cm        | 38.85a          | 0.28b           |
|         | 40–60 cm        | 21.14c          | 0.24b           |

| Table 6 | Available potassium in plantation soil in different years (108 samples) |
|---------|-------------------------------|-----------------|
| Years   | Soil depth      | Quick-acting potassium (mg·kg$^{-1}$) |
| 2a      | 0–20 cm         | 78.35c           |
|         | 20–40 cm        | 106.26b          |
|         | 40–60 cm        | 65.97c           |
| 5a      | 0–20 cm         | 108.35b          |
|         | 20–40 cm        | 114.28b          |
|         | 40–60 cm        | 78.66c           |
| 8a      | 0–20 cm         | 176.29a          |
|         | 20–40 cm        | 154.53a          |
|         | 40–60 cm        | 82.47c           |
promotes the growth and development of vegetation roots, and reduces the application effect of chemical nitrogen and phosphorus fertilizers. It is used as a mountain plant to improve the soil chemical quality in this production area, the most preferred measure.

Construction of comprehensive evaluation indexes for mountain soil quality

If the quality of the planted varieties of crops is guaranteed, increasing the planting yield of the crops as much as possible is the key issue and the main direction of the technology in the planting production area of a mountainous region in this area. The yield and quality of vegetation are more or less related to some physical and chemical properties and biological quality. It not only considers its growth and yield but also takes into account its quality issues. The degree of relevance analyzes the order of the effects of the comprehensive evaluation of soil quality: soil sand (0.952)> available potassium (0.876)> soil clay (0.832)> bulk density (0.783)> total salt (0.776)> total nitrogen (0.683)> available zinc (0.672)> pH (0.653)> total nitrogen (0.643)> capillary porosity (0.621)> available copper (0.593)> alkaline hydrolysis nitrogen (0.573)> microbial biomass phosphorus (0.567)> acidic enzyme activity (0.556)> urine enzyme activity (0.521)> fungi (0.515)> total phosphorus (0.513)> others. The main components were analyzed, and indicators of soil quality were comprehensively evaluated. The order of size is soil clay (0.367), aggregates (0.325), available manganese (0.315), urease activity (0.298), aggregates (0.283), total salt (0.279), non-capillary porosity (0.275), alkaline hydrolysis nitrogen (0.269), available phosphorus (0.225), available potassium (0.219), microbial carbon (0.213), and gross porosity (~0.326). Field water holding capacity (~0.316), soil powder (~0.306), microbial biomass nitrogen (~0.286), etc. reordered in a certain order, organic matter is the largest (21.36%), effective calcium is second (12.36%), sand is the third (9.34%), and available phosphorus, available zinc, and available zinc manganese can all have a higher contribution rate. From the
above data, it can be seen that the two methods of testing are basically the same, and the performance results of the comprehensive quality evaluation are also basically the same. If you consider the representativeness and economy of multiple aspects and integrate various information, 24 indicators can be viewed. Finding a maximum soil parameter problem can also lose as much as possible the data with the smallest amount of soil information in these parameters. s is also analyzed by the texture, field water holding capacity, and capacity in the physical indicators. Each chemical index was composed of 7 keywords, including available potassium, available phosphorus, organic matter and catalase activity. Each comprehensive evaluation index system can effectively reflect the quality of the soil itself in a mountain crop plantation and can further reflect the close connection between soil quality and crop planting products. It can also maintain and improve soil quality issues, optimization issues, and local land resource management and continuous utilization issues, which can effectively promote the advantages of a mountain crop planting area and the sustainable development of the industry in the production area.

Conclusion

A certain mountain crop production area is rich in land resources and has obvious advantages in water-heat coefficient and light temperature. The crop output value garden is relatively fully developed, the pigment formation is good, the sugar content is relatively high, the pH is moderate, and the pests and diseases are not serious. All of the experts have identified it as one of the best ecological cultivation areas in the world. In this paper, a large number of experiments are collected to analyze the physical and chemical properties and biological properties of soil in a mountain plantation area. Systematic studies have been conducted on the relationship between the quality of soil and the growth and development of crops, and the quality of soil factors has a certain relationship.
with the formation of crop yield and quality. A system of soil evaluation indicators has been established and improved. The planting industry of a certain mountain crop provides a realistic theoretical basis and practical guidance for sustainable development. In a certain tunnel experiment, in order to ensure the accuracy of the test results, the sensor calibration experiment is required before data collection, that is, to test its sensitivity. The sensor inside and outside the tunnel must be calibrated before leaving the factory. The purpose is the sensitivity has a large change to a certain extent, and due to changes in temperature, humidity, and dust, its sensitivity will also change. However, inaccurate sensitivity will lead to inaccuracy of the collected acoustic signal results and ultimately affect the inaccuracy of tunnel noise distribution results. This test uses the PAI sound and vibration test analysis system in the figure for data collection. The data collection system has simulated and tested the information data in the digital unit under test on various sensors and other equipment to be tested. The collected information can be processed to obtain a physical meaning of the signal. Then, in the analysis and research of the regional data of a mountain plantation area, the differences between the typical crop plantations, the soil level, and the planting level can be obtained. The number of years and the corresponding indicators are analyzed in research, and it is found that the soil geology is relatively thick, the content of sand is higher than 50% and is affected by the winter climate, the difference between the surface layer and the subsurface layer is very significant, the parent material characteristics of about 2m are more obvious, and the degree of planting and development of crops is not obvious. In general, the content of aggregates is relatively small. With the increase of planting time, the soil depth of the vegetation garden will be more than 0.45mm, which is obviously compared with the previous. The depth has increased a lot, and the soil capacity of the
Fig. 14  Error signal e(n) curve after processing by two algorithms
vegetation garden is relatively large, with an average value of 2.36g or more, but if the value of the bulk density is too large, the growth and development of the root system will be inhibited, and the growth will be restricted and affected.

Declarations

Conflict of interest The authors declare that they have no competing interests.

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