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EFFECT OF SAND COVER ON SOIL WATER AND SALT TRANSPORT AND BARBARY WOLFBERRY GROWTH AND YIELD IN SALINE-ALKALI LAND

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Abstract: The aim is to explore the different sand covering patterns of barbary wolfberry in saline-alkali land (no sand covering as a control, Fine sand covering of 5cm, Fine sand covering of 10cm, 10cm, The effect of coarse sand covering 5cm) on soil water and salt transport and the growth and yield of wolfberry. Using 3a sheng 'Ningqi No. 1' barbary wolfberry as the test material to determine the soil moisture content of 0~100cm in different growth periods, pH, Salt content and composition, etc. The results show that: compared with no sand cover, Under the condition of sand covering, the soil water content during the barbary wolfberry growth period was significantly improved, and the soil pH and whole salt content of saline-alkali land were effectively reduced, and the thickness of coarse sand covering was 5cm, and the salt ion Na was optimal+, K+, SO_2, Cl^-. The inhibitory effect is more prominent. At the same time, different sand covering treatment also promoted the growth and development of Chinese wolfberry, and the branch length increased on average 15. 22%, Barbary wolfberry The yield of all reached extremely significant levels, The 5cm yield, Net income and production and investment ratio are the best, 19. 64%. For the cultivation of barbary wolfberry in saline -alkali arid areas, the overall salt suppression effect of 5cm is the most significant, which is an effective coverage method for the continuous and stable production of barbary wolfberry in Hongsibao irrigated area.
Keywords: Sand covering; Saline-alkali land; Barbary wolfberry; Soil water content; Soil salt content

1. MATERIALS AND METHODS

Ningxia Hongsibao Yanghuang Irrigation Area is located in the arid and semi-arid wind-sand belt in central Ningxia. The climate is dry and less rain, the ground evaporation is large, the surface water and shallow groundwater quantity is less and poor quality, and the water resources are very short[1]. Developing the Chinese wolfberry industry according to the local conditions is the best choice to improve the local ecological environment and promote the regional economic growth. According to the investigation, the area of the existing Chinese wolfberry planting area of 37. 352 million m2, The annual output value can reach 320 million yuan. However, due to the backward cultivation mode, inadequate supporting technology, soil secondary salinization and other problems, the industrial scale and standardized development has been seriously affected. In recent years, drought-resistant and soil moisture conservation cultivation has become an important measure to ensure the sustainable and stable yield of Chinese wolfberry. Sand covering is a unique drought-resistant farming form widely used to adapt to the local environment[2]It has good water storage and moisture conservation, soil temperature improvement, salt and alkali reduction, and suppresses weeds and insect pests and other effects[3]. Some studies have shown that sand and stone cover plays an important role in water saving in dry farming, improvement of saline-alkali land and restoration of vegetation in oasis desert transition zone[4]. Some studies have also shown that the reasonable sand covering thickness has a significant effect on soil water infiltration, evaporation and salt migration in arid areas[5-7].
Domestic and foreign studies on coverage measures mainly focus on the farmland environment and crop yield increase effect after coverage[8-10] Most of the experimental crops are grape, watermelon and jujube, but there are few related studies in saline-alkali barbary wolfberry. In this study, on the basis of previous studies, different coverage thickness tests of coarse sand and fine sand should be set to analyze the influence of different ways of sand covering on the soil characteristics and yield and economic benefits of wolfberry in saline-alkali field, so as to provide technical reference for the sustainable development of wolfberry in saline-alkali field.

1.1 Test Material

The experiment is carried out in Guangcai New Village, the key planting area of Chinese wolfberry promotion in Hongsibao District. The terrain of the area is a mountain front fan-shaped flovial plain, It is a temperate continental climate, The average annual average precipitation is 251mm, Meverage annual evaporation 2387 mm, The annual average air temperature is 8. 7℃, The temperature difference between day and night was 13. 7℃, The annual accumulated temperature of> 10℃ can reach more than 3 200℃, All the annual time of sunshine 2900~3 550h[11]. The soil texture is sandy loam, with moderate heavy salinity, and the basic physicochemical properties are shown in Table 1,

Rainfall and temperature conditions are shown in Figure 1. The varieties of Chinese wolfberry are'Ningqi No. 1 ', planted with 3a.

Table 1 Physical and chemical properties of soil foundation

solum /cm		total salt /organic matter /alkali-hydrolyzable nitrogen			/rapidly available phosphorus /Quick-acting potassium /	
Soil layer	pH	(g/kg) Totalsalt	(g/kg) Organic matter	(mg /kg) Availablenitrogen	(mg /kg) Availablephosphorus	(mg /kg) Availablepotassium
0~20	8. 66	4. 98	3. 92	86	10. 4	198
20~40	8. 92	1. 68	2. 64	38	5. 3	75
40~60	8. 71	1. 12	2. 17	30	5. 2	58
60~80	8. 77	0. 99	1. 9	22	4. 4	62
80~100	8. 71	0. 86	1. 63	22	4. 4	60

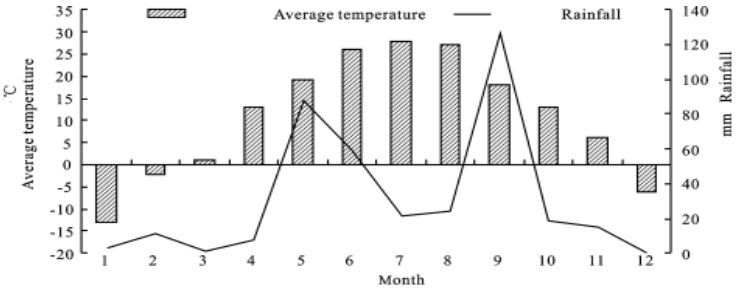

Fig. 1 Rainfall and temperature in the test year (2011)

1.2 Test Design and Method

The trial was conducted in March 2011, There are 5 treatments in total, Are: treatment 1 (fine sand 5cm, F5), treatment 2 (10cm, Note as F10), treatment 3 (10cm, C10), treatment 4 (5cm, Note as C5), treatment 5 (no coverage, CK). random permutation, Repeat 3 times. Each community area is aboutIs at 50 m2, village, The replicates were separated by artificial ridges, Ridge high30cm, The ridge is 40cm wide, The width of ridge bottom is 70cm; irrigation channel are manually excavated to prevent intercrosstalk during irrigation. Before the start of the trial, On March 12, the sand was covered on the surface of each experimental area, phosphate fertilizer, Farm manure is all used in spring, application rates450k g/hm2, 30 000 kg/hm2, Nitrogen fertilizer was determined as pure nitrogen375kg /hm2use, One third of the base, Barbary wolfberry 150kg /hm2, Results initial application 150kg/hm2, Apply after 75 kg/hm in the full fruit period2. The annual irrigation water volume is4500 ~ 6000m3/hm2, Irrigation 3 times, Middle tillage and weeding for 3 times. The degree modulus of fine sand is2. 2~1. 6, The average particle size is 0. 35~0. 25 mm; the degree of coarse sand is 3. 7~3. 1, averageThe particle size was 0. 5mm.

1.3 Determination of the Items and Methods

Soil moisture content: in the different growth period of Chinese wolfberry on April 15, 5Month 24th, On June 23rd, On July 25th, On August 30th, 0-100 cm soil samples were collected on September 22, The drying and weighing method was used to determine the soil water content, and the soil water storage quantity was calculated by using the formula.
Soil salt content: measured, date starting on March 25, Other dates are consistent with the above dates. pH, Total salt according to the soil-water ratio (qualityQuantity ratio) 1 ： 5 to prepare the soil extract, The DDS-308 type A was usedThe soil conductivity (EC) value of the extraction solution is determined, and thenAccording to the empirical formula. put to useCO_3^{2-} was determined by double indicator neutralization titration, And HCO_3^-ion, NO_3^-Cl-, The EDTA indirect complexation titration method
fix SO_4^{2-}ion, EDTA titration for Ca2+And Mg2+,
Flame-based photometric determination of Na+And Ca2+.
Barbary wolfberry Branch growth length: use a tape to determine the branch growth length in different periods, The test date is set on May 19, 5moon29sun, On June 8th, 6Month 18 , 6Month on the 28th, In July, 8sun, On July 18th, On July 28th, On August 7th, On August 17th, On August 27sun.
Yiput: the actual measurement of each community, a total of 7 times a year, The picking date is June 27, respectively, On July 8th, On July 19th, On July 30th, On August 11th, On August 25th, On September 3rd. After each picking, the quality of fresh fruit was measured immediately, and then natural air drying was conducted. After the end of the whole

picking period, the annual output of fresh and dried fruit per unit area of each variety was counted. The ratio of production to investment is net income/total input.

1.4 Data Handling

Test data were significantly different using DPS 7. 0 softwareSex test, Using the MicrosoftExcel 2010, Surfer 16 Mapping and data processing.

2. RESULTS AND ANALYSIS

2.1 Effects of Different Sand Treatments on Soil Moisture Content

Barbary wolfberry The spatial and temporal changes of soil water content from 0 to 100 cm during the growth period are shown in Figure 2, The water content of the soil increased gradually with the increase of soil depth, Gradually decreases with the advancement of the birth period. 0~10cm, The water content of 10~20cm soil layer has a great influence, Was 11. 52% higher on average than CK, The water content of CK from 0 to 10 cm soil layer decreased to 10. 80% in late August, At the same time, low water content appeared in 40cm and 60cm soil layer. This shows that sand covering can contain soil moisture in all seasons, effectively inhibit soil moisture evaporation, and provide a good moisture environment for the root growth of Chinese wolfberry.

F 0~10cm soil F5 and F10, C10 withThe differences in soil water content and water storage between the C5 treatments were highly significant, Meanwhile, the F5, F10, The difference between C10 treatment and CK was also extremely significant, The CK water content was only 11. 93%, The average decrease was 11. 50% compared with the sand treatment, The average soil water content in 1m soil is only 14. 78%, The water storage amount is only 16. 54 mm. 10~20cm, the change of water content of the soil layer is similar to that of 0~10cm, F10 and C5 increased the most, By 14. 86%, respectively, 12. 87%, F5 compared with F10, C10 and C5 treatment, However, the difference with CK reached a very significant level. 20~40cm soil layer, There was no significant difference in water content and storage between the treatments, The difference is small, But differ very significantly from CK, The water content of the sand-covered soil increased by 10. 72% on average, The water storage volume increased by 10. 40%. From 40cm soil to depths below the ground, No significant differences in soil water content were observed between the treatments, From 40 to 60 cm for C5 treatment only, The water storage from 80-100 cm and 60-80 cm from C10 treatment varied significantly from CK, It can be seen from this, Sand sand can significantly affect the soil water content at a depth of 40cm below the ground, 40cm above the ground is the fine sand storage capacity is strong.

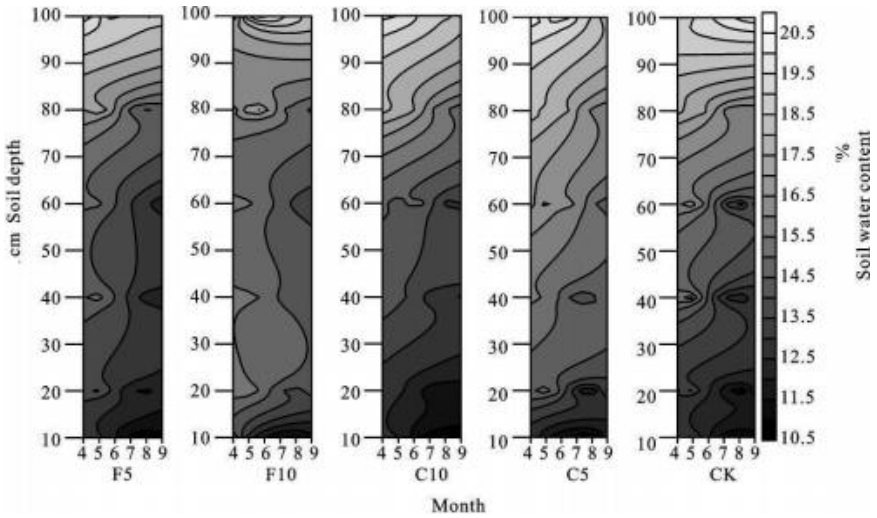

Fig. 2 spatiotemporal distribution of soil water from 0 to 100 cm for different sand burden treatments

2.2 Effect of Different Sand Treatments on Soil PH

2.2.1 Soil pH dynamics were regularly sampled for soil pH

According to different soil layer depths, Salt content was observed. 0 – 20 cm during the barbary wolfberry growth period under different treatments, Soil pH dynamics ranging from 20 to 40 cm are shown in Figure 3. The soil strong strongly strongly in spring, In the 0 to 20 cm soil layer, Each treatment germination period (March25Day) of the soilpHIncreased from the base value, respectively7. 97%, 7. 27%, 5. 31%, 2. 31%, 10. 85%, CK salt and alkali surface poly brightapparent. With the advancement of the growth period, the sand overburden treatment effectively reduced the soil pH from the period before germination to the new shoot growth period (April 15), Then entially by 0. 69, 0. 69, 0.

52, 0. 16, Among them, fine sand has a better effect on pH in spring. From the new shoot growth period to the full flowering period (May24Day) each treatment changes weakened, The amplitude was changed to0. 02~0. 36, It has fluctuated thereafter. Autumn fruit period (September22Day), F5 treatment and CK appeared alkali condition, PH To 9. 33 and 9. 43, F10, C5, The C10 treatment of pH continued to decrease, And 9. 19, respectively, 8. 81 and 9. 09, The effect of coarse sand covering is more prominent, Compared with the average pH reduction of 3. 35%.

20~40cm soil layer, Soil pH in F5 treatment all varied in the range of values below the budding stage before the autumn fruit period, which increased from the autumn fruit stage, It to 9. 48, Consistent with the change trend ranging from 0 to 20 cm. The F10 treatment fluctuated less in pH since the germination stage, It rose slightly during the summer fruit period, Other reproductive periods ranged from 8. 65 to 8. 78. C10, The pH of C5 treatment increased at the beginning of autumn fruit (August 30), Compared with the same period of F5, F10 treatment increased 10. 40%, 11. 10%, But with the advance of the growth period in the autumn fruit peak period (September 22), C10, The C5 treatment effectively reduced the pH level, Inhibition of autumn return base, Compared with the initial autumn fruit decreased by 1. 06, 0. 93, It shows that the inhibitory effect of coarse sand covering on soil alkali in autumn is stronger than that of fine sand in autumn. The reason may be that soil moisture evaporation slows down, and coarse sand covering is conducive to soil ventilation and water storage, which makes the soluble salinity in subsoil and groundwater difficult to gather to the topsoil. The pH of CK began to increase after the peak period (July 25), which was significantly higher than that of other treatments, indicating that sand covering can effectively inhibit the increase of soil pH.

2. 2. 2 Soil profile pH change

The change of soil profile pH in different growth periods is shown in Figure 4, Before germination, each treatment pH changed less with the increase of soil layer depth, 0~100cm soil layer pHThe mean value was 9. 17, respectively, 9. 12, 9. 14, 8. 95, 9. 19. along withAdvances in fertility, The pH was decreased in each treatment during full bloom, The decrease was from 4. 03% to 6. 87%, F5 compared with C5, F10 coincides with the C10 treatment profile change trend, F5 and C5 treatment increased and then decreased with the pH of 40cm soil layer, In F10 and C10 treatment, the pH of 40cm and 60cm soil layer as the inflection point first decreased and then increased, respectively. Summer fruit period, The pH of 0 to 20 cm soil layer increased sharply in F5 treatment, The surface phenomenon is obvious, Decdown gradually from 20cm depth, pH is close to full flowering period; pH of F10 treatmentThe flowering period rises, With an average increase of 5. 21%, 0~20cm, 20~40The pH of cm soil is still lower than the budding stage; the pH of 0-20 cm soil in C10 treatment is basically unchanged, Decline from 20cm downward depth, However, the pH of 40cm soil layer was 0. 29 higher than the flowering period; the pH change of 0-20 cm between C5 and F5 treatment was similar, pH achieve9. 44. The depth of each soil layer is pH in CK, Increase before germination, The average value reached 9. 33. Autumn fruit period, The pH of different treatments showed a downward trend, compared to before germination. During the whole growth period, the pH was the lowest in the full flowering period. in general, There was no significant difference in soil pH changes between the treatments during the different reproductive period, The F5 treatment only for 60~The difference between pH in the 80cm soil layer was extremely remarkable from CK, And was significantly different from the F10 strain, But it decreased with the increase of the soil layer depth, The highest pH is 0 to 20 cm, From 20 to 60 cm fluctuated less and showed an overall decrease, 60~100cm is basically stable without change.

2.3 Effect of Different Sand-Covering Treatments on Soil Salt Content

2.3.1 Dynamic Changes of soil Salinity

0 during the birth period of the different treatments~20cm, The dynamic change of soil salinity in the 20 to 40 cm soil layer is shown in Figure 5. Define the difference between post-harvest and pre-sowing soil salt content as the rate of soil salt accumulation[12]. In the 0 to 20 cm soil layer, The salt content of different treated soil decreased by 49. 19% after autumn fruit compared with before germination, 7. 50%, 35. 61%, 71. 11%, 5. 92%, The root layer of the soil was desalted, The salt suppression rate of the whole birth period was 47. 95% ~ 78. 55%. The CK soil had the highest salt content, The average salt content of 0~20cm soil layer is 3. 17g/kg, Significant significantly from the other treatments (Table 2). C10 and C5 treated the soil from before germination to after autumn fruit, The average salt content of the 0-20 cm soil layer was 0. 76g/k, respectivelyg, 0. 68g/kg, The salt suppression effect was stronger than that of F5, F10 treatment, And C5, The salt content difference between C10 and F5 treatments reached an extremely significant level, A significant levels with F10 treatment, It shows that the sand covering treatment provides a relatively diluted soil environment for the growth of barbary wolfberry, which is conducive to the growth and development of wolfberry plants, especially the coarse sand covering can significantly slow down the soil salt concentration in the shallow root layer of wolfberry, which may be because of the coarse sand diameter is larger, which is conducive to the movement of water and drive the salt movement.

In the 20~40cm soil layer, The salt content of F5 and F10 treatment with the growth period“W”Form trend, C5 and C10“M”Form trend, The CK variable amplitude is smaller. The salt content of the soil was reduced on June 23 fall, And 79. 05% lower than CK, respectively, 15. 24%, 83. 81%, 58. 10%, It shows that different sand covering treatments effectively inhibit the soil salt of barbary wolfberry ripening stage, which is beneficial to fruit expansion. However, soil salinity increased 20 to 40 cm after autumn fruit compared with before germination, increaseThe amplitude are

respectively3. 40%, 47. 79%, 0. 76%, 69. 35%, 25. 00%, There were no significant differences between the respective treatments.

2.3.2 Changes in the soil salt profile

In barbary wolfberry, before budding (March25The soil salt distribution of the treatment section), full flowering period (May 24), summer fruit period (June 23) and autumn fruit period (September 22) is shown in Figure 6: the average salt content of 0~20cm soil layer is 0. 74~3. 29g/kg, 20 to 40 cm, The amplitude is 0. 62~1. 64g/kg, 40 to 100 cm soil layer changes less. sproutBefore the bud, F5, F10, The salt content of C5 treatment and CK soil decreased successively with the deepening of the soil layer, C10 treatment gradually decreased with 40~60cm soil salt content as the inflection point, The salt content of the 0 – 20 cm soil layer was lower than the F5 treatment and CK, However, the salt content of 20-100 cm soil layer was significantly higher than other treatments. Flowering, F5 and F10 treatments were consistent with the CK soil, It decreases as the soil layer deepens, C5 and C10 treatment increased the salt content of 20~40cm, The salt content of coarse sand in 0~20cm soil layer is lower than that of fine sand, The CK salt content was increased to 3. 87g/kg, 14. 50%. Summer fruit period, F10 treatment was consistent with C5 and C10 treatment trends, The salt content of 20-40 cm soil layer was taken as the inflection point to increase first and then decrease, Where F10 was treated from 0 to 20 cm, The salt content of 20~40cm soil layer appeared severe salt return phenomenon, Compared with other reproductive periods, the salt content of 0~20cm increased by 49. 58% on average, The average salt content of 20 to 40 cm increased twice up to 2. 26g/kg, However, C5 and C10 treatments had lower salt content than other reproductive periods, The average salt content of 0 to 100 cm was 0. 71g/k, respectivelyg, 0. 37g/kg. Autumn fruit period, Each treatment shows, now different change trends, Of F10 as compared with C5, The C10 treatment changes remained similar, The F5 treatment was consistent with the CK trend.

in summary, Sand burden treatment significantly affected wolfberry root layer 0~20cm soil salt content, With increasing soil depth, The influence of external factors on soil salt content tends to coincide, similar to the results of previous studies. In this study, the inhibitory effect of coarse sand covering on the salt content of 0 to 40 cm soil layer was stronger than that of fine sand covering, In particular, the C5 treatment effect is more significant, Its 1m soil body has the lowest salt content.

2.3.3 Soil salt ions of 0~20cm

The changes of soil salt ion content before germination and after autumn fruit with different treatments are shown in Figure 7, The soil salt ions are lower than before germination. Before the bud, Ca in the cation2+, Mg2+Less content, The mean value was 0. 22g/kg, 0. 17g/kg, Na+, K+High ion content, The mean value was 2. 80g/kg, 0. 97g/kg. F5, F10, C10, C5 treated Na+Lower ion content compared to CK5. 60%, 51. 15%, 39. 69%, 47. 07%, K+The ion content was 40. 34% compared with CK, 68. 75%, 40. 91%, 73. 30%. The Na treated with F10+, K+Ion content than F 5 treatment, whereNa+The ion content was reduced by 48. 25%, K+Ion content decreased by 47. 62%. Both C10 and C5 were treated with Na+, K+The ion content difference is small. After the autumn fruit, Ca2+, Mg2+, Na+, K+The mean ion content was 0. 14g/k, respectivelyg, 0. 09g/kg, 1. 15g/kg, 0. 59g/ kg, This was 36. 36% lower than before germination, 47. 06%, 58. 93%, 39. 18%. Both C10 and C5 were treated with Na+The lowest ion content was found, And 0. 46g/k, respectivelyg, 0. 56g/kg, 65. 77% lower from F5 and F10 treatments, This mean reduction was 71. 19% from CK. The anion content is the same as the cation content. sproutBefore the bud, CO, HCOThe content is less abundant, The mean value is given as follows0. 19g/kg, 0. 52g/kg, SO Cl-The content is relatively higher, The mean value is given as follows2. 16g/kg, 1. 31g/kg. F5, F10, C10, SO of C5 for treatmentThe ion content vsCKLower levels, respectively31. 92%, 73. 32%, 54. 36%, 70. 82%, Cl-The ion content is compared with CKLower levels, respectively7. 28%, 66. 99%, 47. 09%, 61. 65%. SO treated with F10SO_4^{-2}, Cl-The ion content was lower than that found in the F5 treatment, among SO_4^{-2}The ion content was reduced by 60. 81%, Cl-The ion content was reduced by 64. 40%. And C5 for the processing of the SO_4^{-2}, Cl-The ion content as compared to C10Treatment was 36. 07% lower, 27. 52%. After autumn fruit, The mean content of each anion was 0. 09g/k, respectivelyg, 0. 42g/kg, 0. 96g/kg, 0. 50 g/kg, It was reduced by 52. 63% compared with before germination, 19. 23%, 55. 56%, 61. 83%. SO treated with C10 and C5, Cl-ionThe lowest content, The mean values were 0. 43g/k, respectivelyg, 0. 23g/kg, More F5AndF10handleSO_4^{-2}The ion content was decreased on average65. 87%, Cl-The ion content decreased by 64. 06%, 69. 72% and 69. 33% from CK. in summary, The inhibitory effect of salt ions was stronger by F10 than by F5 treatment, C5 was stronger than the C10 treatment, Thick sand is stronger than fine sand, useC5 treatment for soil Na+, K+, SO, Cl-The most inhibitory effectclear.

2.4 Different Sand Cover Treatments for Barbary Wolfberry Shoot Growth, Output and Economy, the Impact of Benefits

Different sand cover treatments had significant or very significant effects on barbary wolfberry shoot growth and yield. among, F5, F10, C10, The growth length of C5 treated branches varied significantly from CK, The average increase was 15. 22%, Increased by 2. 74cm, respectively, 4. 95cm, 5. 44cm, 7. 21cm. C5 and C10 treatments, Especially the C5 treatment withF5, F10, The C10 treatment was also very significantly different, By 12. 37%, respectively, 5. 89%, 4. 56%. The yield aspect is reflected with the branchesAnd with similar growth patterns, C5, C10, And F10 treatment versus CK differenceVery significant, The production rate increased by 19. 64%, 13. 15%, 15. 21%, F5 treatment

varied significantly from CK, The yield was increased by 10. 68%, It shows that alkali can promotes the growth and yield of wolfberry.

The economic benefit analysis shows that under the condition of the same sand grain, with the increase of sand thickness, the cost of coarse sand under the same sand thickness is higher than that of fine sand, but the different sand treatment increase the net income and production ratio, Compared to the CK, F5, F10, C10, C5 increased, plus the income was 14, 895 yuan/hm respectively2, twenty thousand, two hundred and eighty-three yuan /hm2, sixteen thousand, three hundred and fourteen yuan /hm2, twenty-eight thousand, three hundred and twenty-nine yuan /hm2. C5 processing production has the highest production-investment ratio, More F5, F10, The C10 treatment was increased by 11. 83%, 9. 25%, 14. 55%, A 26. 85% improvement compared with CK.

3. DISCUSS

Soil water content is one of the main factors restricting the growth and development of plants. Sufficient water is conducive to the absorption and utilization of mineral elements by roots, thus promoting the plant metabolism, photosynthesis and other physiological and biochemical processes[13]. Poesen class[14]Studies of the effect of sand covering the surface on soil moisture under very dry conditions discuss the effectiveness of this measure for soil and water conservation. The saline-alkali surface cover can reduce the surface loss of water, effectively inhibit the evaporation of soil water, and increase the soil storage capacity[15]. Zhang Yi et al[16]The study shows that in the gully region of the Loess Plateau, the soil moisture profile differentiation is the highest, which improves the water content of the root layer and is conducive to the water utilization of fruit trees. Sun Wentai et al[17]Research shows that sand covering can effectively increase the horizontal distribution range and vertical depth of root system, and increase the absorption space of water and fertilizer of root system. In this study, the effects of different sand covering treatments from 0 to 100 cm, This result shows that sand covering can significantly increase the soil moisture content during different growth periods of barbary wolfberry, especially in the 0-40 cm cultivated layer, Not just the soil moisture content in a certain growth period, it is obviously better than other covering measures. The grass mulching and film mulching measures in related studies generally only provide a good water environment for the plant emergence and seedling growth[18-20]. besides, In this study, the soil moisture content was 10cm thick, Optimbest treatment with C10, This is with Zhou et al[21]The results were consistent.

Soil salinization is another major factor restricting plant growth and development. High soil alkalinity can reduce the effective supply of mineral elements in the soil, affect the nutritional balance in the plant body, and thus lead to slow down or even damage of plant growth[22]. In the production practice, different sand covering thickness and depth have a great impact on soil pH[23]. In this study, sand cover treatment significantly reduced soil pH from 0 to 20 cm, The effect of coarse sand covering on inhibiting the alkali return of soil in autumn is more prominent, Compared with the average pH reduction of 3. 35%. Li Juan[24]The size and difference of the soil indexes in the 0-60 cm soil layer were also analyzed, and the results showed that the soil pH was significantly reduced, And the best effect is with the 15cm of sand covering. In the vertical direction, PH Lower with increasing depth, 0~20cm of the highest soil layer pH, The 20-60 cm soil layer fluctuation is less and the overall decline, The 60~100cm soil layer is basically stable and unchanged, which is consistent with Wu Suli[25] Mary class[26]The research results are consistent.

The effect of sand covering on soil salinity varies according to the difference of soil type and climate conditions. Salt-alkali land surface sand covering has significant salt suppression effect, which can significantly reduce the upward migration and surface concentration of soil salt. With the increase of sand cover thickness (5~15cm), it helps to increase the non-capillary pore, improve the soil pore structure, and enhance the ecological adaptability of plants to salt stress[27]. Wang Chengbao et al[28]The study pointed out that the sand covering treatment has a good desalination effect on the salt of 0~20cm soil layer, It can weaken the salt return of 0~40cm soil layer in the leisure season. Liu Hu Jun et al[29]The study found that when the thickness of sand covering increased to 2cm, the soil salt decreased significantly, especially after washing the salt soil in the summer high temperature period, sand was used to cover the ground, which had the effect of inhibiting the concentration of all ions in salt, and with the increase of sand covering thickness, the inhibition effect was enhanced. The results of this study also showed that sand mulching treatment effectively inhibited soil salt accumulation, During the growth period of 0~20cm, the total salt inhibition amplitude of the soil layer was 47. 95% ~ 78. 55%. The salt suppression effect of coarse sand covering is stronger than that of fine sand covering, C5 treatment is the most obvious salt inhibition effect, The salt content of 1 m soil is the lowest, which may be due to the loose texture and good permeability, which is conducive to the movement of water and the downward movement of salt.

In addition to the effects on soil water and salt, sand cover significantly promoted the growth of barbary wolfberry branches and improved the yield of Chinese wolfberry. The promoting effect of coarse sand covering is stronger than that of fine sand covering, Among them, C5 treatment of wolfberry during the whole growth period increased 7. 21cm compared with CK, The production rate increased by 19. 64%.

From the economic benefit, sand through increasing the output of wolfberry and increase income and production and investment ratio. [30-34]This shows that the plant height, stem thickness, leaf area and dry matter mass of the saline-alkali soil were increased throughout the growth period, which is consistent with the results of this study.

In this study, the soil physical properties, nutrients, organic matter and other indexes were not analyzed, but some studies believed that the organic matter and nutrients of soil in long-term sandy orchards decreased with the increase of soil depth, which reduced the deep accumulation of nitrate in the soil and increased the ammonium nitrogen content in the root area[35]. Further research should be carried out on the effect of water, heat and salt in saline soil and the change of mineral nutrients under the saline-alkali land sediment mulching measures.

4. CONCLUSION

In the cultivation and management of barbary wolfberry in the saline-alkali arid area of Hongsibao, surface sand covering is an effective way to cover, which can significantly improve the soil water content and show good salt suppression effect, and then promote the growth and development of wolfberry, Increase barbary wolfberry production. Comprehensive consideration thinks, C5 treatment (covering 5cm of coarse sand) shows good economic and ecological benefits, and is an important cultivation technology to improve the level of saline-alkali soil fertility and water storage and moisture conservation ability, and ensure the continuous increase of saline-alkali land barbary wolfberry. It can be applied to production practice in combination with scientific farming measures and agronomic technology.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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