Water Status and Survival Rate of Seabuckthorn Seedling in Different Wind Speed and Soil Water Content

Han Ruilian, Li Lixia and ***Liang Zongsuo***

Institute of Soil and Water Conservation, Chinese Academy of Sciences and Ministry of Water Resources, Yangling Shaanxi Province, 712100, China
E-mail: liangzs1@ 163.net

Abstract: The afforestation season of seabuckthorn is often faced the condition of soil drought and dry windy in the soil and water erosion area of loess plateau. When seedling of seabuckthorn is transplant. The function of root absorption is injury and easy lose stalk water in the condition, So seedling sprout difficult. Our research results showed: When wind speed is 6m/s. If the soil water content lower than 14.5%,the survival rate is decreased. When soil is drying and wind speed increased, seedling water content reduced to 1.2 and water potential is lower than –2.5MP.the seedling is not sprout .The survival rate of seabuckthorn is very low. So we think that conservation water balance of seedling is important role in afforestation on Loess Plateau.
Keywords: seabuckthorn, seedling, water balance, survival rate

It is one key factor that seabuckthorn sprout seedling water effect its survival rate. It was often faced short of soil water and more wind during seabuckthorn plantation season in Loess plateau. It isn't recovered by the function of seedling root absorbent water after plantation . So seedling easy lose water and reduce plantation survival rate, serious restrict seabuckthorn resource construction.

We research seabuckthorn seedling water after plantation process of seedling sprout for raise seabuckthorn survival rate, discuss the relation of seedling water and seedling survival rate under different soil water and wind speed, explore a new plantation drought-relief measures for raise seabuckthorn survival rate.

1 Materials and methods

1.1 Plant materials

It was one year old seabuckthorn seedling. We choised seedling which almost same size, robust and good root system, transplanted into 25cm high. 20cm internal diameter pots filled with loess. The soil unit weight was 1.14g/cm^3, every pots was filled 7,500cm^3 soil. The seedling was raised in greenhouse.

It was set up 2 wind speeds level and 4 soil water level. It was definitted wind speeds on 3m/s and 6m/s by hand wind speed an emoneter everyday at 12:00 —15:00 for 3 hours and measure every index at 15:00 —18:00 .The soil water was treated 12%, 14.5%, 17%and 19%, respectively was equaled to field capacity 50%, 60%, 70% and 80%. The soil field capacity was 24.1%. Each treatment was 3 repeat, total 36pots which 24 sampling and 12 statistics seedling survival rate and growth rate, 8 seedling/pot. It was treated by wind speed from transplant to sprout for 7 days. It was controled by soil water from transplant to reach need soil water content, statisticsed seedling survival rate and spread out leaves after didn,t treat for 14days. It was total 21days.

1.2 Measure index and methods

It was dried seedling water content and soil water ca ntent by the oven and weigh. The atmospheric relative humidity and temperature was measured by CID-301PS portable photosynsystem, Seedling water potential was measured by 3,005 pressure chamber, sprout growth after treatment 14days.

2 Results

2.1 Different soil water content and wind speed affect seabuckthorn seedling water and seedling survival rate

Table 1 shows the effect of seedling water content by wind speed and soil water content. Experiment beginning seedling water was 2.05, Respectively seedling water different reduce after transplantation 1d to 5days and obvious difference after transplantation 6th day. Wind speed was obvious affected seedling water under same soil water content. When beginning transplantation soil water was 14.5% which wind speed were 3m/s and 6m/s, seedling survival rate varied between more than 1 times. When beginning transplantation soil water content was 12%, wind speed were 3m/s and 6m/s seedling water content was 0.7 —0.73, and seedling survival rate was 0. So it was obvious affected seedling survival rate by seabuckthorn soil water content and wind speed, special soil water content was lower.

Table 1 Seedling water content in different days after transplanting under different soil content（%）

Soil water content (%)	wind speed (m/s)	Seedling water content in different days after transplanting								Survival rate（%）
		0	1	2	3	4	5	6	7	
12	3	2.05	1.41	1.61	1.50	1.32	1.02	0.76	0.73	0
	6	2.05	1.28	1.14	1.11	0.91	0.78	0.70	0.70	0
14.5	3	2.05	1.85	1.97	1.67	1.47	0.88	0.99	1.29	54
	6	2.05	1.66	1.19	0.97	0.94	0.92	0.89	0.88	26
17	3	2.05	1.88	0.80	0.90	1.14	1.16	2.22	2.29	78
	6	2.05	1.36	0.89	1.06	1.02	1.18	1.32	1.46	71
19	3	2.05	1.80	0.96	0.98	1.21	1.50	4.16	3.32	100
	6	2.05	1.68	0.94	0.92	0.09	1.05	2.25	2.46	98

2.2 Different soil water content and wind speed effect seabuckthorn water potential

Table 2 shows the effect of seabuckthorn water potential was affected by different soil water content and wind speed (The results were the seedling branch water potential after transplantation 6th days), wind speed was obvious affected seedling water potential under same soil water content and soil water content had not clearer affected seedling water potential than wind speed .The seedling branch water potential were reduced –2.7MPa and –2.9MPa by two kind of wind speed when soil water content was 12%, and seedling survival rate was O. When soil water content was 14.5%, the seedling branch water potential was increased –2.0MPa under wind speed was 3m/s, seedling survival rate was 54%. When wind speed was 6m/s, the seedling branch water potential was decreased only 26%. The wind speeds had obvious affected seedling branch water potential and seedling survival rate under given condition from experiment results.

Table 2 Seedling water potential in different wind and soil water content [a]

Soil water content（%）	Seedling water potential (MPa）	
	wind rate (3m/s)	wind rate (6m/s)
12	–2.7	–2.9
14.5	–2.0	–2.6
17	–1.6	–2.5
19	–1.4	–1.8

When the seedling branch water potential was lower than –2.5MPa, the seedling survival rate was lower than 50%, so it was a key factor that the seedling branch water potential was higher, and raised seedling survival rate in afforestation.

2.3 Soil water content and wind speeds effect young branch growth after seabuckthorn sprout

Table 3 shows the results of seedling transplantation 14th day (after transplantation 21day). The soil water content and wind speed had obvious affected leaves differentiated and young shoot spreat during seedling sprout. When wind speed was smaller and soil water content was higher, young branch elongated faster, leaves number were more than wind speed was bigger, soil water content was lower, seedling branch water potential below –2.5 MPa.

Table 3 Seedling sprout growth in different wind and soil water content [a]

Soil water content （%）	Mean of bud elongation（cm）		Amount of per young shoot	
	3m/s	6m/s	3m/s	6m/s
12	0	0	0	0
14.5	0.91	0.66	7	6
17	1.53	1.31	9	8
19	2.13	1.94	12	11

2.4 Wind speed effect seedling ambient temperature and humidity

Table 4 shows the effect of seedling ambient temperature and humidity during seedling sprout wind speed could decreased the seedling ambient temperature 0.2℃ — 0.3℃ and ambient humidity 1% — 3%. The bigger wind speed could make seedling forming thicker greyish white wax in epidermis under same soil water content, and protect seedling water. The results show wind speed not only reduced ambient relative humidity but also serious deceased seedling water content. So it is a key factor of raising seedling survival rate that avoid wind effect in loess plateau afforestation too wind and arid environment.

Table 4 The change of temperature(℃) and relative humidity(RH%)[a]

	Wind rate (m/s)	Temperature（℃） and relative humidity（RH%）in different days						
		1	2	3	4	5	6	7
Temperature	3	22.7	21.7	22.4	22.6	21.6	20.1	18.1
	6	22.5	21.5	22.3	22.2	21.4	20.1	18.0
Relative humidity （RH%）	3	51.5	61.8	65.5	62.1	72.6	69.8	56.3
	6	50.1	61.7	62.7	60.5	70.4	68.8	56.2

3 Discussion

Seabuck thorn native distribution area and artificial afforestation are arid, a few rainfall, too wind environment, special afforestation was faced soil arid and more wind environment in spring and autumn artificial afforestation key period and led to seedling survival rate was lower. The experiment was made a systematic study seabuck thorn seedling water balance in given control soil water content and imitation wind speeds. The results show the seedling water content, branch water potential, seedling survival rate, young branch growth, every branch mean leave number were obvious affected by soil water content and wind speeds. The soil water content was below 14.5% (field capacity 60%), wind speed was 6m/s, seabuck thorn seedling survival rate was only 26%. Seedling water content was below 1.0, but the wind

speed was 3m/s, the seedling survival rate was over 54%, seedling water content was 1.29. The seedling survival rate was higher, branch growth was longer, leaves number were more under two factors and seedling water potential equaled –2.5MPa. The seedling survival rate was greatly decreased; branch growth and leaves number were obvious reduced under seedling branch water potential equaled –2.5MPa . Seabuck thorn seedling, survival rate was more affected by wind speed than soil water content. The wind speeds could be reduced seedling water content because seedling sprout was easier than strike root. Seedling shoot had numerous sprout epidermis lost a great quantity water after sprout in wind and root function didn't still recover absorbent water. When afforestation seedling root system soil water content was below 14.5%. Wind speed was 6m/s at 3h everyday. Seedling water content dry weigh was smaller than 1.2, water potential was below –2.5MPa, seedling was difficult survival, even a few seedling survival and the seedling growth was restrained after afforestation 7days in the experiment and this condition didn't adapt plantation. The effective method of cutting out a section stem and covering up the seedling with earth should be adopted in seabuck thorn artificial afforestation in loess plateau arid and a few rain area because seabuck thorn had strong sprout and regeneration. The seedling survival rate was lower because seedling root absorbent area was greatly injured, absorbent water function was reduced after seedling transplantation in soil dry, more wind and atmosphere dry in spring afforestation. It was found the seedling young root and root hair were greatly injured. Root absorbent water function was reduced in afforestation after research seedling water balance. The water was greatly lost through the stem cortical pore and cuticle in more wind and atmosphere dry spring afferestation season, special the embryomic put forth buds and injured epidermic protection, increased lost water, and damaged seedling water balance, led to seedling water content reduce. The seabuck thorn bud sprout and growth were earlier than root growth and function recovered from our observation consumed seedling-self water and reduced seedling water content. The seedling of inside and outside factor were disadvantageous to keep seedling water balance and it was difficult finished sprout-strike root-spread out leaves-survival after afforestation under atmosphere dry, soil dry and less rain environment. So seedling survival rate was lower.

It is the effective method of keeping seedling water balance and afforestation practice. The brief method was fellows: reduce transpiration to lose water, promote root system absorbent water, keep seedling water content balance, and raise afforestation seedling survival rate, specific measure are. (1) Ensure seedling quality, special keep the whole of seedling root system. (2) Choise the seedling from afforestation locality, reduce seedling lost water during transportation and adapt local dry climate. (3) Spread the cutting out a section of stem and covering up the seedling with earth, take advantage of loess ventilation, seedling was strong regeneration after cutting out a section of stem, effective prevention was lost seedling water by wind, avoid water quickly lost, the kind of apex growth dominant stronger was covered in afforestation and reduce lost water. For example set up windbreak at soon. (4) The seedling root was treated by soak root. Hydroscopic, stimulant root at el. increased root system absorbent water. (5) Water lost was prevented by covered plastic film, grass collect runoff water, level steps, against sloping field, didn't ensure lost water and raised survival rate.