

Innovation in the management innovation of planting methods of vegetation in the southwestern edge of Mu Us Sandy land--from a sustainable development view

Xing Li^{1a}, ZHU Yan-feng^{2b}, Jianmin He^{1c}, BingJie Hou^{1d}

¹College of Economics and Management, Longdong University, Gansu 745000, China

²Forestry Research Institute in Qingyang, Qingyang city, Gansu 745000, China

^alixing@ldxy.edu.cn, ^bgsqylkszyf@126.com, ^cee_he96@126.com,

^dmonkeyber@126.com

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1. Introduction

Management innovation is an important means for an organization to pursue superiority and maintain their competitive edge. In China, the selection of trees for the prevention and control of sand is mainly based on the biological environment of the dunes, special properties of tree types and empirical judgment, all qualitative analysis based approaches. As a result, the outcome of planting the trees selected this way is not ideal and this tree type selection method needs improvement in terms of scientific and advanced properties. Therefore, like what was learned from past sand prevention studies which emphasized rational efficiency in the selection of trees to plant for prevent sands (Rogers, 1976), trees planted for restoring vegetation should be selected according to the land conditions and the restoration targets and with certain necessary sifting technologies. Only in this way can we make sure that the selection be scientific and the restoration of vegetation be a success, achieving sustainable development.

The northern part of Huan County is located in southwestern edge of the Mu Us Sandy Land and is in the transitional place between the Mengxi Plateau and the Huangtu Plateau of China, being a typical juncture of agricultural and husbandry areas. It's also the area most severely affected by wind and sand in Longdong, Gansu. The environmental conditions in the area is very unique and ecological problems are prominent and complex. The unique ecological environment of this area has determined the growth and distribution of the vegetation and also determined that the plants used for restoring the vegetation there should be special. Conducting a research and experiment on the method for selecting tree types



for vegetation restoration in this area is of great significance for northwest China and places of similar ecology.

2. Research Background

In this study, we have selected 18 plants in the tree, shrub and grass categories. 6 are trees, which include, *Pinus sylvestris* L. var. *mongolica* Litv, *Platycladus orientalis* (L.) Franco, *Populus alba* var. *pyramidalis* Bge, *Populus diversifolia* Schrenk, *Rhus typhina* Nutt and *Elaeagnus angustifolia* Linn. 10 are shrubs, which include *Sabina vulgaris* Ant, *Salix psammophila* C. Wang et Ch. Y. Yang, *Hedysarum fruticosum* Pall. var. *Mongolicum*, *Hedysarum scoparium* Fisch. et Me, *Amorpha fruticosa* Linn, *Caragana Korshinskii* Kom, *Caryopteris clandonensis*, *Sambucus williamsii* Hance, *Artemisia desteriorum* Spreng Syst. Veg, and *Hippophae rhamnoides* L. 2 are grasses, which include *Astragalus adsurgens* Pall and *Medicago falcata* L. 4 plants are locally grown in Qingyang City, Gansu Province of China, which are *Platycladus orientalis* (L.) Franco, *Populus alba* var. *pyramidalis* Bge, *Caragana Korshinskii* Kom and *Hippophae rhamnoides* L. The other 14 plants are all brought in from elsewhere.

We have selected fixed and semi-fixed dunes that cover a relatively large area as the research target. To be specific, we established a vegetation restoration experiment demonstration zone in the Hegou Shoal of Tianshuijie Village, Tianshui Township, Huan County and used the 25-mu broad-leaved mixed forest and the 25-mu shrub forest as the basic research target and respectively set fixed survey and monitoring sample lands.

In response to different restoration types, we set survey sample lands respectively. We set 10m×10m quadrats and survey 30 trees or shrubs in the sample lands at random. In the first year, we surveyed the survival rate. In the third year, we surveyed the preserving rate and measured the tree heights, length of branches that grow in the measuring year and the crown width with meter sticks and measured the diameter at breast height and the ground diameter of trees with vernier caliper.

By considering the adaptability to the environment, growth conditions and resilience of the selected trees, we classified the growth conditions of the trees into excellent, good, average, bad and worse grades for assessment. The specific classification and assessment standards are displayed in Table 1.

Performance status	excellent	good	commonly	difference	Worst
adaptability	Fully adapt to local environmental conditions	It is suitable for the growing environment	Able to adapt to local environmental conditions	Not adapt to local environmental conditions and site conditions	Completely unable to adapt to local environmental conditions
Growth status	Vigorous growth, can blossom with luxuriant foliage	Growth is relatively strong, branches, leaves and other basic growth is good	Branches and leaves are sparse, can maintain the crown and tree	The branches and leaves are sparse, and the crown type is incomplete	Stems dysplasia, serious pests and diseases, crown scattered

Table1 Growth status evaluation of tree species classification table

3. Analysis

To narrow down the scope of trees that can be selected for vegetation restoration and reduce the difficulties of ensuing analysis, in accordance with the survival rate, preserving rate and growth of the plants, we did a preliminary sift of the 18 tree types experimented and had a qualitative assessment of their adaptability, survival rate, preserving rate and growth. (As shown in Table 2)

Table2 Survival rate, preserving rate and growth status of different species

varieties of trees	Number of seedling	Survival rate (%)	Preservation rate (%)	Average tree height (cm)			Ground diameter (cm)			crown width (cm)			shoot growth			Growth status
				2012	2013	2014	2012	2013	2014	2012	2013	2014	2012	2013	2014	
<i>Amorpha fruticosa</i> Linn	30	89	83	62.9	79.7	103.1	1.29	1.3	1.31	69.83	90.78	102.2	38.19	44.07	45.6	good
<i>Pinus sylvestris</i> L. var. <i>mongolica</i> Litv	30	95	89	98.3	109.25	116.7	2.83	3.26	3.42	49.65	57.98	62	6.94	7.82	8.1	excellent
<i>Populus alba</i> var. <i>pyramidalis</i> Bge	30	94	79	131.5	160.6	216.5	2.35	2.6	3.22	22.1	24	78.85	36.16	37.54	71.8	good
<i>Platycladus orientalis</i> (L.) Franco	30	91	86	97.9	111.1	123.6	1.81	2.06	2.28	41.9	46	49.25	11.05	13.25	14.35	good
<i>Elaeagnus angustifolia</i> Linn	30	85	85		94.6	100.7		1.06	1.08		23.45	26.67		8.95	12.47	good
<i>Populus diversifolia</i> Schrenk	30	3	0													good
<i>Sabina vulgaris</i> Ant	30	96	94	19.9	25.77	37.8	0.66	1.15	1.2	27.65	33.37	38	9.27	11.61	13.1	excellent
<i>Caragana Korshinskii</i> Kom	30	91	94	17.3	27.2	53.5	0.32	0.5	0.95	13.05	16.3	29.4	8.7	9.65	12.68	excellent
<i>Caryopteris clandonensis</i>	30	94	84	22.7	46.7	68.8				26.1	32.55	55.45	16.78	17.38	21.8	good
<i>Hippophae rhamnoides</i> L	30	45	86	61.1	36.7	84.54	0.88	0.88	1.45	16.4	15.9	33.6	12	11.7	15.43	common only
<i>Hedysarum fruticosum</i> Pall. var. <i>mongolicum</i> (Turcz.) Turcz	28	90	86	20.1	45.4	84.3				18.3	39.8	64.4		23.4	22.7	excellent
<i>Hedysarum scoparium</i> Fisch. et Mey.	26	85	87	17.8	41.3	75.2				17.8	38.5	62.2		21.6	20.4	excellent
<i>Sambucus williamsii</i> Hance	28	73	39			25.9						35.9			20	difference
<i>Artemisia destororum</i> Spreng	25	84	88	51.6	95.4	145				88.3	142.6	156.3	75.4	85.3	105.93	excellent
<i>Salix psammophila</i> C	27	27				55.4						32.1			20.3	difference
<i>Rhus typhina</i> Nutt	30	10	0													difference
<i>Astragalus adsurgens</i> Pall	20	66	90			94.4						60.2			94	good
<i>Medicago falcata</i> L	30	95	93	27		45.7				25.15		37.15	153.75		16.98	good

The result suggests that *Populus alba* var. *pyramidalis* Bge, *Pinus sylvestris* L. var. *mongolica* Litv, *Artemisia destororum* Spreng Syst. Veg, *Hedysarum fruticosum* Pall. var. *mongolicum* (Turcz.) Turcz, and *Hedysarum scoparium* Fisch. et Mey have larger growth increment and better adaptability to the environment, suitable to be the pioneering tree seedlings for ecological restoration in the dunes in the north of Huan County. *Medicago falcata* L is used relatively more widely in the production and ecological restoration of the local region and can be used as the major candidates in the grass category.

4. Conclusion

This research adopts the southwestern edge of the Mu Us Sandy land of Huan County of Gansu Province as the subject, upholds scientific planting and sustainable development as the core and have discovered through management innovation that tree type selection is the key chain of ecological restoration and that the appropriateness of the tree types selected directly affects whether the introduction of trees can succeed and the overall restoration effects. The specific conclusion is as follows:

(1) According to the survival rate, the preserving rate and the growth, we had a comprehensive assessment of the 18 types of trees commonly used in ecological restoration and the result suggests that 7 shrubs (including *Hippophae rhamnoides* L, *Caryopteris clandonensis*, *Artemisia desteriorum* Spreng Syst. Veg, *Caragana Korshinskii* Kom, *Amorpha fruticosa* Linn, *Hedysarum fruticosum* Pall. var. *mongolicum* (Turcz.) Turcz, and *Hedysarum scoparium* Fisch. et Mey.), 4 trees (including *Pinus sylvestris* L. var. *mongolica* Litv., *Populus alba* var. *pyramidalis* Bge, *Platycladus orientalis* (L.) Franco and *Elaeagnus angustifolia* Linn), and 1 grass (*Medicago falcata* L.), altogether 12 plants grow well in this region and are plants that can be selected for the local restoration work for sandy and deteriorated land.

(2) By ranking the competitive matrix according to appropriateness, we confirmed that shrubs are the types of plants that should be given first priority to when selecting plants for regional ecological restoration. And among all the plants in the experiment, the ranking of them in terms of appropriateness is: *Caragana Korshinskii* Kom > *Hedysarum fruticosum* Pall. var. *mongolicum* (Turcz.) Turcz > *Hedysarum scoparium* Fisch. et Mey. > *Artemisia desteriorum* Spreng Syst. Veg. > *sabina vulgaris* > *Amorpha fruticosa* Linn. > *Populus alba* var. *pyramidalis* Bge > *Caryopteris clandonensis* > *Pinus sylvestris* L. var. *mongolica* Litv. > *Platycladus orientalis* (L.) Franco. Therefore, when selecting plants for ecological restoration in the sandy areas of the southwestern edge of the Mu Us Sandy land, we should make the decision based on the ranking above. By doing so, we can significantly improve the status quo of sand prevention planting that upholds sustainable development as the core.

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