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PHYTOMELIORATIVE ROLE OF SHRUB BELT IN ROADSIDE PLANTATIONS

Ivanisova N. V.[1], Kurinskaya L. V.[1], Kolesnikov S. I.[2], Davydenko N. M.[1]

[1]Novocherkassk Engineering and Land Reclamation Institute named after A. K. Kortunov, Donskoy State Agrarian University, Novocherkassk, Russia
[2]Academy of Biology and Biotechnology, Southern Federal University, Rostov-on-Don, Russia
E-mail: lyubov.kurinskay@mail.ru

Along the federal roads of the Rostov region, Krasnodar Territory and the Stavropol Territory, it is increasingly possible to find clean plantations consisting of one or two tree species, with a completely destroyed bush belt. In 62 % of the plots studied, the shrub belt is represented by species of scumpia (Cotinus coggygria, 17 %), terna (Prunus spinosa, 9 %), elm (Ulmus parvifolia, 5 %), maple (Acer tataricum, 3 %), that is, resistant to anthropogenic and climatic factors steppe The bush belt in protective roadside strips plays a significant role in the accumulation of soil moisture (by 6.3 %), humus (by 2.4 %), in reducing the noise load (by 25 dB). Ancestral and overband shrubs make it possible to create a dense structure of forest strips, which fully performs protective functions both from drifts of the highway bed with snow, and to reduce the negative impact of vehicles on adjacent landscapes. The study of the phytomeliorative role of the shrub belt in existing roadside plantations is a relevant area of research for the further development of recommendations for the creation and maintenance of protective roadside plantings in the steppe zone of southern Russia.
Keywords: shrub, phytomeliorative role, soils, roadside plantations, noise, illumination.

INTRODUCTION

Roadside protective plantations in the steppe zone of southern Russia play a significant role in the regulation of wind flows, the distribution of heat, moisture and pollutants. Many years of experience of steppe forestry has proved that plantations should be multicultural, consisting of the main and accompanying breeds and the shrub belt [1]. The bush belt is a component of protective forest stripes located either up to the main forest stripes or after. It prevents the penetration of steppe elements under the canopy of plantations.

To create sustainable plantations, it is necessary to take into account the natural and climatic conditions, functional purpose and environmental and biological characteristics of each species. Shrub belt in protective plantations performs soil protective role, reduces evaporation of moisture, prevents blowing [2], reduces overgrowth by weed vegetation, reduces noise pollution [3]. But recently, there has been a tendency when creating or caring for protective plantations not to design a bush belt, but to introduce or leave only the main or accompanying breed. Along the federal roads of the Rostov region, Krasnodar and Stavropol Territory, clean plantations consisting of one or two tree species with a

completely destroyed bush belt are increasingly found. The study of the reclamation role of the shrub belt in existing roadside plantations is a relevant area of research for the further development of recommendations on the creation and maintenance of protective roadside plantations in the steppe zone of southern Russia [4].

MATERIALS AND METHODS

The research was carried out in the period 2017–2019, two motor roads were chosen as the research targets: of the federal (M4 Novocherkassk-Rostov) and regional significance (Novocherkassk-Shakhty), experiencing various anthropogenic impacts (fig. 1).

Fig.1. Map – scheme of location of objects of research.

The distance from the roadbed edge to the forest growing stock was considered when laying the test areas (TA). The sampling area was located at a distance directly near the road, 10–100 m from the growing stock and under the growing stock, in the zones of the so-called "edge" effect of the impact of vehicles on ecosystems and especially on biota.

The assessment of the protective roadside growing stock state is given in accordance with the tree state category scale (Sanitary rules in forests of the Russian Federation, 2013).

Single samples were taken on the TA from the upper soil horizon by the envelope method. PH of water extract (GOST 26423-85), humus determination by I. V. Tyurin method (GOST 26213-91) were determined in soil samples. The assessment of the noise protective role of the shrub zone was carried out in the state with leaves and without them using the Testo 816-4 sound level meter. The measurements were carried out in front of, in and behind growing stock directly from the noise source [5]. Measurement of luminosity in growing stock with participation of a shrub zone and without it was carried out by means of the TKA-Lux luxmeter.

RESULTS AND DISCUSSION

According to the current recommendations, the roadside forest strips in the steppe zone are formed by means of a shrub zone. Which is located either immediately after the road ditch part, or after the protective strips on the side of adjacent agricultural fields [6]. The main types of shrub vegetation and their ecological and biological features are presented in table 1. Considering climatic and anthropogenic factors, the stability of shrubs in the system of roadside growing stock was assessed separately.

Table 1

Ecological and biological features of the roadside growing stock shrubs of the steppe zone

№	Sort	Relationship to illumination	Relation to soil	Relation to moisture	Stability
1	**2**	**3**	**4**	**5**	**6**
1	Amórpha fruticósa	light-loving.	undemanding	undemanding	3 (not resistant to salinization)
2	Ulmus parvifolia	light-loving	exacting	drought-resistant	3
3	Cotinus coggýgria	shade-tolerant	undemanding	drought-resistant	1
4	Ácer tatáricum	shade-tolerant	undemanding	drought-resistant	1
5	Caragána arboréscens	light-loving	undemanding	undemanding	1
6	Ligústrum vulgáre	shade-tolerant	those with low	drought-resistant	1
7	Lonícera tatárica	shade-tolerant	undemanding	drought-resistant	1
8	Elaeágnus angustifólia	light-loving	undemanding	drought-resistant	2
9	Ribes aureum	shade-tolerant	undemanding	drought-resistant	1

Continuation of table 1

10	Tamarix	shade-tolerant	undemanding	drought-resistant	2
11	Prunus spinosa	light-loving	undemanding	drought-resistant	1
12	Rosea cinnamomea	light-loving	undemanding	drought-resistant	1
13	Hippophae	light-loving	undemanding	exacting	2
14	Córylus avellána	shade-tolerant	undemanding	drought-resistant	3
15	Córnus mas	shade-tolerant	exacting	drought-resistant	3 (not resistant to dry winds)
16	Amelanchier vulgaris	light-loving	undemanding	drought-resistant	4
17	Swida sanguinea	shade-tolerant	undemanding	drought-resistant	1

Stability category: 1 – stable; 2 – medium-stable; 3 – unstable for abiotic and biotic factors; 4 – based on anthropogenic factors.

Taxation description of roadside protective plantings at the studied objects is given in Table 2. The predominant breed in protective plantations is Robinia pseudoacacia and Fraxinus lanceolata. In multi-row bands, all other things being equal, the life activity of trees and shrubs is influenced by their spatial placement and breed composition, which determine the degree of competitive relations between them [5].

Table 2

Taxing characteristic of roadside protective plantations

№	**Location**	**The predominant sort**	**Number of rows in the lane**	**The edges line up with the side of the road**	**Shrub belt inside plantings**	**Edge rows on the side of agricultural fields**
Novocherkassk- Shakhty						
1	50 m from the road	*50 % Robínia pseudoacácia and 50 % Fraxinus lanceolata*	6	-	*Ulmus parvifolia*	*Prunus spinosa*
1.1	20 m from the road	*50 % Robínia pseudoacácia and 50 % Fraxinus lanceolata*	6	-	*Ulmus parvifolia*	-
2	50 m from the road	*50 % Robínia pseudoacácia and 50 % Ácer negúndo*	6	*Cotinus coggýgria*	-	*Elaeágnus angustifólia*
2.1	20 m from the road	*50 % Robínia pseudoacácia and 50 % Fraxinus lanceolata*	6	*Cotinus coggýgria*	*Ulmus parvifolia*	-
3	20 m from the road	*50 % Robínia pseudoacácia and 50 % Fraxinus lanceolata*	6	*Cotinus coggýgria*	*Ácer tatáricum*	*Prunus spinosa*

Continuation of table 2

3.1	50 m from the road	*50 % Robínia pseudoacácia and 50 % Fraxinus lanceolata*	6	*Cotinus coggýgria*	*Ácer tatáricum*	-
Rostov-on-Don - Novocherkassk						
4	20 m from the road	*80 % Robínia pseudoacácia and 20 % Quércus róbur*	5	-	*Swida sanguinea*	-
4.1	20 m from the road	*50 % Robínia pseudoacácia and 50 % Fraxinus lanceolata*	6	*Cotinus coggýgria, Swida sanguinea*	-	*Prunus spinosa*
5	50 m from the road	*60 % Robínia pseudoacácia and 30 % Fraxinus lanceolate and 10 % Quércus róbur*	7	*Cotinus coggýgria, Swida sanguinea*	-	*Prunus spinosa*
5.1	20 m from the road	*50 % Fraxinus lanceolata and 50 % Robínia pseudoacácia*	6	*Cotinus coggýgria, Swida sanguinea*	*Swida sanguinea*	-
6	50 m from the road	*60 % Fraxinus lanceolata and 20 % Populus pyramidalis, 10 % Quércus róbur, 10 % Ácer negúndo*	7	*Cotinus coggýgria, Swida sanguinea*	-	*Rosea cinnamome a*
6.1	10 m from the road	*100 % Fraxinus lanceolata*	1	-	-	-

The highest percentage (more than 62 %) in the studied roadside growing stock is occupied by the shrub zone consisting of *Cotinus coggýgria*, 17 % – *Prunus spinosa*, 9 % – *Ulmus parvifolia*, 5 % – *Ácer tatáricum*, i.e. from species resistant to both anthropogenic and climatic factors of the steppe zone

When studying the soil protection role of the shrub zone, special attention was paid to such edaphic factors as pH, humus content, aggregate composition, soil moisture (table 3).

On the test area without a shrub zone, there is a decrease in the content of humus, soil compaction and a decrease in humidity. In the presence of a shrub in the edge tree rows and inside the growing stock, soil moisture and humus content is increased. It is also noted that in the test areas with the shrub zone, the middle loamy neutral soils predominate and moisture evaporation decreases.

The presence of the shrub zone up to 1.5 m in height significantly increases the noise absorbing capacity of roadside forest strips (table 4). But the greatest noise absorbing effect of the shrub tier is observed from the roadbed.

For effective dispersion of sunlight in roadside forest strips, its width should be more than 30 meters with several shrub species both in the edge tree rows on the roadbed side and inside the growing stock (table 4).

Table 3

Influence of the shrub zone on the roadside landscapes soils

№	Shrubby belt	pH	Content of humus, %	Aggregate content (%): <0.25 mm	Humidity, %
1	inside plantings and beyond the band belt	7,80±0,06	5,80±0,06	0,60±0,07	4,69±0,08
1.1	inside plantings	7,60±0,11	6,66±0,06	0,16±0,02	6,17±0,37
2	forest edge number	7,30±0,11	5,66±0,06	0,46±0,05	5,50±0,41
2.1	forest edge number and inside plantings	7,90±0,11	4,76±0,03	0,80±0,06	5,35±0,36
3	forest edge number and inside plantings	7,80±0,11	6,82±0,07	0,50±0,11	5,11±0,22
3.1	forest edge number and inside plantings	7,50±0,11	5,00±0,13	0,56±0,02	4,69±0,61
4	forest edge number	7,70±0,17	6,05±0,09	0,16±0,01	6,86±1,36
4.1	forest edge number	7,60±0,06	8,30±0,14	0,40±0,13	6,73±0,27
5	forest edge number	7,80±0,09	5,02±0,05	0,27±0,01	6,12±0,61
5.1	forest edge number and inside plantings	7,70±0,06	5,76±0,12	0,20±0,08	6,87±0,11
6	forest edge number	7,80±0,11	3,83±0,07	0,83±0,02	8,67±0,09
6.1	control (inside plantings)	7,60±0,06	2,66±0,07	0,10±0,03	3,94±1,04

Table 4

Influence of shrubs on noise pollution and illumination

№	Noise pollution, decibel			Illumination, Lux		
	before	inside	behind	before	inside	behind
1	74±3,02	59±2,0	50±3,39	16,8±0,25	2,5±0,47	7,8±0,80
1.1	82±1,58	70±3,81	63±4,80	9,2±0,52	5,6±0,27	11,3±0,20
2	78±2,09	63±2,65	60±2,00	19,5±0,33	4,6±0,33	6,7±0,39
2.1	80±1,87	75±1,58	75±1,58	10,3±0,22	2±0,32	18,3±0,72
3	60±3,32	55±2,92	53±4,80	3,5±0,46	3,0±0,45	7,4±0,23
3.1	78±1,58	67±4,42	60±2,92	7,3±0,27	6±0,33	15,1±0,22
4	80±3,87	32±2,35	70±1,41	68,6±0,71	2,6±0,27	19,2±0,48
4.1	90±2,45	45±2,92	60±2,00	76,0±1,51	0,08±0,03	70,0±0,73
5	95±5,34	50±1,22	60±3,74	66,0±2,12	2,6±0,47	66,5±0,49
5.1	90±3,46	55±1,58	95±2,24	31±2,55	0,03±0,02	32,0±0,47
6	80±1,41	50±2,55	70±2,70	31,4±1,20	18,5±0,37	32,0±1,10
6.1	80±6,20	75±1,00	55±2,24	27,4±0,44	30,6±1,12	35,6±2,08

CONCLUSIONS

The presence of two or more shrub rows in the edge tree rows of protective growing stock allows to reduce moisture evaporation, over-compaction and acidification of the upper soil horizon.

Roadside forest strips of dense impermeable construction with the shrub species allow to achieve maximum noise reduction from the motor road, to reduce luminosity at frontal and lateral lighting of the roadbed.

The introduction of two or more shrub species into the system of protective growing stock will allow to create a sustainable phyto-meliorative phytocoenosis.

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Вдоль федеральных дорог Ростовской области, Краснодарского края и Ставропольского края все чаще можно встретить чистые насаждения, состоящие из одной или двух древесных пород, с полностью уничтоженным кустарниковым поясом. В 62 % исследованных насаждений кустарниковый пояс представлен видами скумпии (*Cotinus coggygria*, 17 %), терна (*Prunus spinosa*, 9 %), вяза (*Ulmus parvifolia*, 5 %), клена (*Acer tataricum*, 3 %), есть устойчивыми к антропогенным и климатическим факторам степной зоны. Кустарниковый пояс в защитных придорожных полосах играет существенную роль в накоплении почвенной влаги (на 6,3 %), гумуса (на 2,4 %), в снижении шумовой нагрузки (на 25 дБ). Прикюветные и заполосные кустарниковые насаждения позволяют создать плотную конструкцию лесных полос, которая в полной мере выполняет защитные функции как от заносов полотна автодороги снегом, так и по снижению негативного влияния автотранспорта на сопредельные ландшафты. Изучение фитомелиоративной роли кустарникового пояса в существующих придорожных насаждениях является актуальным направлением исследований для дальнейшей разработки рекомендаций по созданию и содержанию защитных придорожных насаждений в степной зоне юга России**.**

Ключевые слова: кустарник, фитомелиоративная роль, почвы, придорожные насаждения, шум, освещенность.