BIOMASS PRODUCTION IN TWO TROPICAL HERBACEOUS LEGUMES AS INFLUENCED BY THE STRUCTURAL CHARACTERISTICS OF MINE SPOIL

ARVIND SINGH

Department of Botany,
Baranaras Hindu University, Varanasi (Uttar Pradesh).

Introduction

Drastically disturbed mine spoils are nutritionally and microbiologically poor habitats (Singh and Jha 1993). Natural restoration of mine spoil is a slow process (Iverson and Wali, 1982). Establishment of herbaceous cover by seeding legumes is an important strategy to accelerate the process of revegetation, as it ameliorate the habitat fertility by addition for nitrogen and organic matter, subsequently paving way for other species to colonise. The objective of the present investigation is to evaluate the influence of structural characteristics of mine spoil on biomass yield of two tropical herbaceous legumes seeded for revegetation of coal mine spoil. The two herbaceous legumes used in the study are *Stylosanthes hamata* and *Stylosanthes humilis*. The former is erect in form while the latter spreads on the ground forming a thick mat. Both of them are drought resistant and hardy in nature, capable of growing in poor marginal and worn out lands.

Material and Methods

The study was conducted at Jayant coal mine in the Singrauli Coalfields. The coal fields of Singrauli extend over 2200 km^2 (latitude 23°47' – 24°12' N; longitude 81°48' - 82°52' E and elevation 280-519 m a.m.s.l., of which 80 km^2 lie in Sonebhadra District of Uttar Pradesh and rest in Sidhi District of Madhya Pradesh. The climate is dry tropical with temperature reaching upto 48°C during June and lowering down to 5°C in January. Rainfall varies from 90-100 cm confined during monsoon months from June to September. The potential natural vegetation is a tropical dry deciduous forest.

Several experimental plots (20 m x 20 m) were set up on fresh coal mine spoil in July 1995, at two different sites of varying structural characteristics. Based on the percentage of fine soil particles one was designated as more rocky spoil site while the other was designated as less rocky spoil site. At more rocky spoil site the percentage of <2 mm soil particles was 14% and water holding capacity was 31%, whereas at less rocky spoil site the percentage of <2 mm particles was 25% and water holding capacity was 34%. At both the sites the legumes *Stylosanthes hamata* and *Stylosanthes humilis* were seeded at the rate of 7 kg ha^{-1} separately in different plots.

The legumes crop at its peak was harvested for both the species separately using three 1 m x 1 m quadrats for more

rocky spoil site and less rocky spoil site in October 1995. Shoot biomass in each quadrat was harvested at ground level, and root biomass was sampled using 25 cm x 25 cm x 30 cm monoliths. The monoliths were washed with a fine jet of water on 2.0 and 0.5 mm mesh screens. The shoot and root biomass was oven-dried at 80°C to constant weight. Differences between the site means for significance were tested through two-tailed Student's t-test.

Results and Discussion

The data for root biomass, shoot biomass, total biomass and root/shoot ratio for both the sites are summarised in Table 1. Results of the study revealed marked influence of structural characteristics of mine spoil on root and shoot biomass production in both the herbaceous legumes. In *S. hamata,* compared to more rocky spoil site, the root, shoot and total biomass production was 18%, 32% and 28% greater at less fertile spoil site, respectively. Similarly in *S. humilis,* the root, shoot and total biomass production was 19%, 31% and 26% greater at less fertile spoil site, respectively, compared to more rocky spoil site. Thus the response to structural characteristics for root, shoot and total biomass production at less fertile spoil site was more or less similar for both the leguminous species. The study also suggests that the response to structural characteristics of mine spoil was greater for shoot biomass than root biomass. In *S. hamata* the root, shoot and total biomass significantly differed between the two sites while in *S. humilis* the root biomass did not differ significantly between sites but the shoot and total biomass differed significantly between the two sites. In general the biomass production capacity was greater for *S. hamata* at both the sites compared to *S. humilis*.

Structural characteristics of the spoil had marked effect on root/shoot ratio also. The root/shoot ratio was greater at more rocky spoil site in both the species. However, significant difference between both sites for root/shoot ratio was found only in *S. hamata*. The level of ratio was similar at both sites for both the species. The greater ratio at more rocky spoil site suggests greater allocation to root part in tough

Table 1

Root biomass, shoot biomass, total biomass and root/shoot ratio in two herbaceous legumes seeded on mine spoil at two different sites with varying structural characteristics

Species	Site	Biomass (g m^{-2})			Root/shoot ratio
		Root	Shoot	Total	
Stylosanthes hamata	More rocky spoil	79 3[a]	176 3[a]	255 4[a]	0.44 0.01[a]
	Less rocky spoil	93 4[b]	233 11[b]	326 15[b]	0.39 0.01[b]
Stylosanthes humilis	More rocky spoil	62 4[a]	140 4[a]	202 8[a]	0.44 0.02[a]
	Less rocky spoil	74 3[a]	181 5[b]	255 8[b]	0.40 0.01[a]

(Mean ± 1SE)
Values in a column for a species with different letters are significantly different from each other at $P<0.05$.

habitats. Virtually the more rocky spoil site would have lower nutrient holding capacity owing to lesser percentage of fine soil particles. Thus the greater allocation to root part in more rocky spoil is a device to enhance nutrient uptake. Several studies suggests greater allocation to root parts in nutrient poor habitats (Keyes and Grier, 1981; Tilman, 1988; McMurtrie and Landsberg, 1992).

Conclusion

The study suggest that besides nutrients, structural characteristics are also the determinants of dry matter yield in plants. The spoil with greater percentage of fine soil particles promotes greater biomass production than the spoil having lower percentage of fine soil particles.

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SUMMARY

The effect of structural characteristics of mine spoil was studied on biomass production of two tropical herbaceous legumes *Stylosanthes hamata* and *Stylosanthes humilis*. The structural variation had marked influence on biomass production. The root, shoot and total biomass production was greater at less rocky spoil site than more rocky spoil site in both the leguminous species. However, the root/shoot ratio was greater at more rocky spoil site than less rocky spoil site in both the species.

खान दूषण की संरचना विशेषताओं से प्रभावित दो शाकीय उष्ण शिम्बियों का जैवपुंज उत्पादन

अरविंद सिंह

सारांश

खान दूषण की संरचना विशेषताओं के प्रभावों का अध्ययन दो उष्णदेशीय शाकीय शिम्बियों *स्टायलोसैन्थेस हैमाटा* और *स्टा० ह्युमाइलिस* को लेकर किया गया। संरचना भिन्नता का जैवपुंज उत्पादन पर दर्शनीय प्रभाव पड़ा। अधिक चट्टानी दूषित स्थल की तुलना में कम चट्टानी दूषित स्थल की जड़ों, प्ररोहों और कुल जैवपुंज का उत्पादन दोनों शिम्बि जातियों में ज्यादा पाया गया। किन्तु, जड़/प्ररोह अनुपात इन दोनों जातियों में कम चट्टानी दूषित स्थलों की तुलना में अधिक चट्टानी दूषित स्थलों में अधिक रहता पाया गया।

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