(II)

BIOMASS YIELD IN A TROPICAL HERBACEOUS LEGUME *STYLOSANTHES HUMILIS* SEEDED ON A MINE SPOIL WITH AND WITHOUT INORGANIC FERTILIZER AMENDMENT

Introduction

Open cast mining activity results in huge dumps of overburden material as mine spoils. These dumps are drastically disturbed and nutritionally and microbiologically poor habitats (Singh and Jha, 1993). Mine spoils consisting of haphazardly mixed, consolidated and unconsolidated material are highly susceptible to erosion. Therefore, revegetation of mine spoils becomes inevitable to stabilize it against the erosive forces to avert contamination of water bodies and adjacent agricultural lands from harmful leachates. Establishment of herbaceous cover by seeding legumes stabilizes mine spoil and ameliorates the fertility status by addition of nitrogen and organic matter to it. To overcome the problem of nutrient poverty, fertilizers are often applied. Several field study reports indicate that fertilizer amendment has marked effect on biomass yield of herbaceous legumes on mine spoil (Richardson and Evans, 1986; Borgegård and Rydin, 1989; Scoenholtz *et al.*, 1992). The aim of the present study is to analyze the biomass yield of a tropical herbaceous legume *Stylosanthes humilis* seeded on a coal mine spoil with and without fertilizer amendment. *Stylosanthes humilis* is a perennial drought-resistant hardy legume native to Central and South America. It is of short stature and generally spreads on the ground forming a thick mat. Thus it is ideal plant for soil conservation which substantially adds organic matter and nitrogen to the soil. It also serves as an excellent fodder for cattle owing to its high protein content.

Material and Methods

The study was performed at Jayant coal mine of the Singrauli Coal fields. The Singrauli coal fields spread over an area of 2200 km^2 (latitude 23°47' – 24° 12' N, longitude 81°48' – 82°52' E and elevation 280-519 m above mean sea level), of which 80 km^2 lie in the Sonebhadra district of Uttar Pradesh and remaining in Sidhi district of Madhya Pradesh. The climate is tropical monsoonal and the year has a mild winter (November-February), hot summer (April-June) and a warm rainy season (July–September). Mean monthly minimum temperature within annual cycle ranges from 6.4 to 28°C and mean monthly maximum from 20 to 42°C. The annual rainfall averages at 106.9 cm, 90% of which occurs during the period between June to September. Winter rains are negligible as compared to warm rainy season.

The texture of the spoil material was 80% sand, 10% silt and 10% clay, with a pH of 7.4, total of N 0.018% and total P of 0.010% (Singh, 1999). Soil cores to a depth of 10 cm consisted of 75% of particles greater than 2 mm in diameter. Geological formation is susceptible to erosion overlying sandstone with coal seams of varying depth between 8 to 135 m thicknesses. The potential natural vegetation is a tropical dry deciduous forest (Champion and Seth, 1968) having moderate to good density bearing heavy pressure of grazing and firewood of local population.

Revegetation experimental plots of 20 m x 20 m size each were set up on a fresh coal mine spoil in July, 1995. Each experimental plot was divided into four sub-plots of 10 m x 10 m size. One sub-plot was treated with full strength of NPK, another sub-plot with half strength of NPK and two sub-plots were maintained as control without fertilizer amendment. The full strength fertiliser was N in the form of urea @20 kg ha^{-1}, P in the form of single super phosphate @40 kg ha^{-1} and K in the form of muriate of potash @40 kg ha^{-1} In each sub-plot five 20 cm wide and 10 cm deep furrows spaced 2 m apart were dug. The fertilizer mixture was spread in furrows first and then *Stylosanthes humilis* was seeded at a rate of 7 kg ha^{-1}. Urea and single super phosphate were applied in granular form and muriate of potash in powder form.

Three plots were selected for the biomass study. The legume crop at its peak was harvested from three, (25 cm x 25 cm) quadrats (one harvest per plot) in October 1995 for control, half strength NPK and full strength NPK treatment plots. Shoot biomass in each quadrat was harvested at ground level, and root biomass was sampled using 25 x 25 x 30 cm monoliths. The monoliths were washed on 2.0 and 0.5 mm mesh screen with a fine jet of water. The root and shoot biomass was oven dried at 80°C to constant weight. Differences between treatment means were tested for significance through a two-tailed Student's *t*-test (Snedecor and Cochran, 1968). The root-shoot biomass relationship was explored through regression analysis.

Results and Discussion

Results revealed positive impact of NPK

Table 1

Root and shoot biomass, total biomass and root/shoot ratio of Stylasanthes humilis seeded on mine spoil under two different levels of NPK treatment along with control (Mean 1 S E).

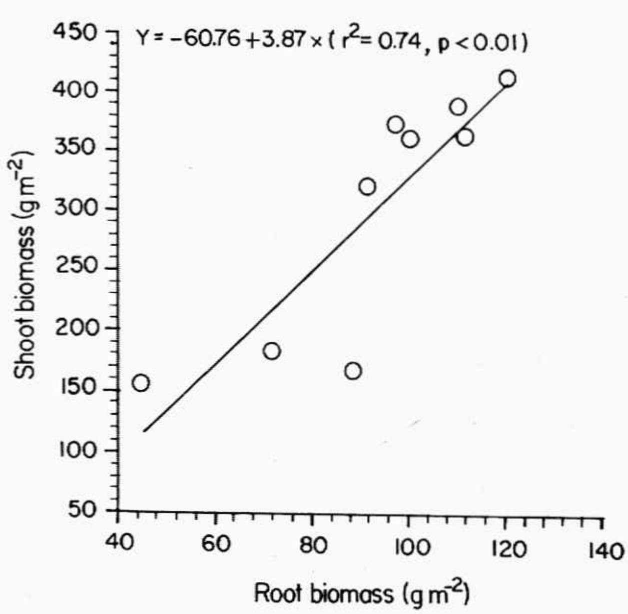
Treatment	Biomass ($g\ m^{-2}$)			Root/shoot ratio
	root	shoot	total	
Control	69 ± 11 [a]	167 ± 8 [a]	236 ± 18 [a]	0.40 ± 0.05 [a]
Half strength NPK	101 ± 6 [b] (46%)	347 ± 14 [b] (108%)	448 ± 9 [b] (90%)	0.28 ± 0.03 [a]
Full strength NPK	110 ± 8 [b] (59%)	390 ± 12 [b] (134%)	500 ± 18 [b] (112%)	0.27 ± 0.01 [a]

Values in a column suffixed with different letters are significantly different from each other at $P < 0.05$.
Values in paranthesis indicate per cent increase over control.

fertilizer amendment on the biomass yield of *S. humilis* seeded on a coal mine spoil (Table 1). Compared to control, the root biomass was 46% and 59% greater in half strength and full strength NPK fertilizer treatment plots, respectively. However, compared to control, the shoot biomass was 108% and 134% greater in half strength and full strength NPK amendment plots, respectively. This clearly indicates that the influence of fertilizer amendment was greater on shoot biomass than root biomass. Compared to this study on legume, the grass *Pennisetum pedicellatum* was found to be far more responsive to NPK fertilization in terms of biomass yield on mine spoil at the same site (Singh *et al.*, 1996). In comparison to half strength NPK treatment, the root biomass was only 9% and shoot and total biomass was only 12% greater in full strength NPK treatment plots. This suggests that the biomass increase is not proportional to fertilizer strength. The root, shoot and total biomass were significantly greater in fertilizer amended plots compared to control plots. However, the root, shoot and total biomass did not differ significantly between half strength and full strength NPK treatment, suggesting that compared to half strength NPK treatment, full strength fertilizer treatment had no effect on biomass yield. Thus the root, shoot and total biomass yield show a sign of saturation at full strength NPK fertilizer level.

Although the root/shoot ratio decreased from control to full strength NPK treatment, however, the differences among treatment was not significant (Table 1). This reveals that the fertilizer amendment had no effect on root/shoot ratio. Nevertheless, the greater root/shoot ratio in control plots suggests that allocation to below-ground part is greater in nutrient poor habitats than nutrient rich habitats. The greater proportion of assimilate allocation to roots on nutrient poor sites is owing to limitation of nutrient supply (Keyes and Grier, 1981; McMurtrie and Landsberg, 1992). In nutrient poor habitats plants are adapted by an increase in biomass allocation to structure that enhance nutrient absorption (Tilman, 1988). Contrary to the present finding, other studies report greater allocation to root part in nutrient rich habitats (Ingestad and Agren, 1991; Singh *et al.*, 1996). In the study, the root biomass was positively related with shoot biomass (Fig. 1).

Fig. 1



Relationship between root biomass (X, $g\ m^{-2}$) and shoot biomass (Y, $g\ m^{-2}$) of *Stylosanthes humilis* seeded on a coal mine spoil.

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