栽植間隔の異なるクズ(Pueraria lobata Ohwi)群落の第1回越冬直後の親根株と発根節の空間分布

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Spatial Distribution of Parent Stumps and Rooted Nodes Just after the First Overwintering of Kudzu (Pueraria lobata Ohwi) Stands Differing in Spacing

Hyoe Tsugawa*, Yoko Hori* and Thomas S. Sasek**

(Received for publication on August 9, 1994)

Abstract

Forty-day-old kudzu seedlings were transplanted at 40 × 40, 80 × 80 and 120 × 120 spacings on 26 June 1987. The distribution patterns of rooted nodes alone and in association with parent stumps (i.e. crowns) were examined using Morisita’s I* index in early March, the following year. In 40 cm spacing, spatial distribution of rooted nodes was contagious (or clustered) only in the quadrat size of 25/64 m² (62.5 cm grid). The contagious distributions in 80 and 120 cm spacings were observed in the quadrat sizes of 25/128 m² (44.2 cm grid) to 25/32 m² (88.4 cm grid), and 25/64 m² and 25/32 m², respectively, in rooted nodes and crowns. In all the cases of the contagious distributions of rooted nodes and crowns, the degree of contagiousness (or clustering) was low.

From the facts mentioned above, it is assumed in the first year of kudzu growth that root systems are distributed avoiding competition from neighbors and utilized effectively the ground surface and that they are efficiently arranged to prevent soil erosion.

Introduction

In the utilization of kudzu-vine as plant cover, the covering degree of ground surface by leaf canopy, dry matter accumulation, and the quantity and age composition or magnitude of overwintering stems and root systems which constitute a kudzu network should be discussed when we try to determine what spacing is adequate. Forty and 80 cm spacings gave superior ground cover by the leaf canopy to that of 120 cm spacing in first year kudzu stands*. Stem thickness and the magnitude of root systems in 80 cm spacing exceeded those of 40 cm spacing**.

A well-established network of kudzu-vine is required not only to have strong, dense components but also to have their even distribution over the stand. For example, when the spatial distribution of parent stumps and rooted nodes are intensively contagious (clustered), root systems compete for nutrients and water, which prevents the effective use of ground surface, and a disadvantage occurs in soil retention.

From the above mentioned view-point, spatial distribution of parent stumps and rooted nodes was elucidated just after the first overwintering in kudzu stands planted at different spacings.

Materials and Methods

Forty-day-old kudzu seedlings were transplanted with different spacings of 40 × 40, 80 × 80 and 120 × 120 cm between plants on 26 June 1987 (experimental plot area : 8.5 × 8.5, 7.5 × 10.5 and 7.5 × 11.5 m, respectively). In early March of the following year, 25 adjacent quadrats were placed within an area measuring 5 × 5 m at the centers of the kudzu stands and distribution maps locating parent stumps (the original plants) and rooted nodes were prepared. On the basis of the maps, distributional patterns of parent stumps and rooted nodes (hereafter, only in case when

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*Laboratory of Crop Science
**Department of Biology, Northeastern Louisiana University, U.S.A.
parent stump and rooted node are described in a lump, the term "crown" is used) were compared among spacings, using Morisita's $I_s$ index. If rooted nodes and crowns are distributed at random over the area, $I_s$ will take the value of unity. When the distributions of rooted nodes and crowns are uniform or contagious, the $I_s$ value will be smaller or larger than unity, respectively. Since parent stumps were transplanted at fixed intervals, it is thought that the distribution pattern of crowns tends to be more uniform than that of rooted nodes alone. Accordingly, diagnosis of distributional pattern was calculated in two ways, rooted nodes alone and in association with parent stumps (crowns).

Raising seedlings, fertilizer application, irrigation and weeding were conducted as detailed in the previous paper.

**Results and Discussion**

The numbers of parent stumps and rooted nodes in 25 m² each of three experimental plots differing in spacing are listed in Table 1. The proportional numbers of crowns in 40, 80 and 120 cm spacings were 100, 69 and 62%, respectively. The proportion of parent stumps to crowns was 17% in 40 cm spacing, while only 6 and 3% in 80 and 120 cm spacings, respectively.

The distribution pattern of rooted nodes in 40 cm spacing was recognized to be random or uniform in all quadrat sizes except 25/64 m² (62.5 cm grid).

<table>
<thead>
<tr>
<th>Plant spacing (cm)</th>
<th>Parent stump</th>
<th>Rooted node</th>
<th>Total (Crown)</th>
</tr>
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<tbody>
<tr>
<td>40 × 40</td>
<td>149</td>
<td>730</td>
<td>879</td>
</tr>
<tr>
<td>80 × 80</td>
<td>36</td>
<td>569</td>
<td>605</td>
</tr>
<tr>
<td>120 × 120</td>
<td>17</td>
<td>528</td>
<td>545</td>
</tr>
</tbody>
</table>

*Fig.1 $I_s$-quadrat size relationships in the distribution of rooted nodes in the 1st year kudzu stands differing in spacing.*

- O-O : 40 cm, △-△: 80 cm, □-□ : 120 cm spacing

Solid symbols show significant departure from randomness ($I_s = 1.0$) at the 1% level.
Spatial Distribution of Kudzu Crowns

Fig. 2  $I_x$-quadrat size relationships in the distribution of crowns (parent stumps + rooted nodes) in the 1st year kudzu stands differing in spacing.

- $\circ$ : 40 cm spacing
- $\triangle$ : 80 cm spacing
- $\square$ : 120 cm spacing

Solid symbols show significant departure from randomness ($I_x = 1.0$) at the 1% level.

(Figs. 1 and 2). The spatial distributions of rooted nodes and crowns in 80 cm spacing were observed to be contagious in quadrat sizes from $25/128$ m$^2$ (44.2 cm grid) to $25/32$ m$^2$ (88.4 cm grid). In 120 cm spacing, rooted nodes and crowns showed a contagious distribution only in quadrat sizes of $25/64$ m$^2$ and $25/32$ m$^2$. However, the degree of contagiousness (or clustering) were low in all quadrat sizes in which their distributions were nonrandom.

Stem length production per m$^2$ in 80 and 120 cm spacings was 42 and 41 m respectively, with less than half that in 40 cm spacing. In the kudzu stands in which plants were spaced at more than 80 $\times$ 80 cm, it is thought that unevenness in stem distribution is likely to occur in the first year of growth, due to the fact that stems can not fully pervade throughout the stands. The presence of greater numbers of quadrat sizes exhibiting a contagious distribution in more than 80 cm spacings was probably caused by more intensive unevenness in stem distributions which is reflected in the spatial distributions of rooted nodes and crowns.

Contagious distributions of rooted nodes and crowns were observed in quadrat sizes from $25/128$ m$^2$ to $25/32$ m$^2$ in all spacings. From the results in the previous paper, the number of crowns produced per m of stems was calculated as 0.35 (40 cm spacing) - 0.48 (80 cm spacing). In other words, this indicates that stem length of 2.1-2.9 m is required for producing one crown. The contagious distribution observed in small quadrat sizes was thought to be associated with the number of crowns produced per unit stem length. However, a series of our findings obtained from the previous studies are insufficient to explain it. The spatial distribution of kudzu crowns should be discussed with reference to data on morphological characteristics, growth habits and environmental response of kudzu-vine associated with rooting.

From the results in this study, it was found that rooted nodes were fairly uniformly distributed with no major difference in distribution pattern among the 1st year stands in which kudzu seedlings were spaced at 40 $\times$ 40 cm to 120 $\times$ 120 cm. Accordingly, in spacings of this range, it is assumed that root systems are distributed escaping competition with each other and utilized effectively the ground surface and that they are efficiently arranged to prevent soil erosion.
References


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親根株と発根節の空間分布
津川兵衛・堀 庸子・T.W.SASEK

要 約

1987年6月26日に40日齢のクズ実生を40 × 40、80 × 80および120 × 120 cm間隔で植え付けた。翌年3月
上旬に3栽植間隔につき、森下の1q指数を用いて、発根節のみ、およびこれに親根株を含めた場合の分布様式
を調べた。40 cm間隔では発根節のみの25／64 m²（62.5 cm角）の枠面積で集中分布が認められたにすぎなかっ
た。80 cmおよび120 cm間隔では発根節のみ、および親根株を含めた場合とも、それぞれ25／128 m²（44.2 cm角）
一25／32 m²（88.4 cm角）、25／64 m²と25／32 m²の枠面積で集中分布が認められた。なお、いずれの場合と
も分布の集中程度は低かった。

これらの事実から、本研究で用いた栽植間隔の範囲内では、根群は競合を避けるように分布し、地表面を有
効に利用するとともに、土壌流亡防止の上でも効果的に配置するものと思われる。