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Minimum Sampling Size and Minimun Quadrat Number for Weed Data Collection in Transplanted Rice

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移秧畓에서 植生分析을 위한 最少標本抽出 方法에 관한 硏究

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ABSTRACT

Species-area and species-quadrat number curves were used to determine the minimum sampling size and the minimum quadrat number for weed data collection in transplanted rice.

In both cases, characteristic curves that first increased abruptly and then leveled off as fewer species were added with increased sampling size or quadrat number were obtained.

Using these techniques, it was determined that three quadrats each 0.3m^2 (0.5m x 0.6m) in area were needed to adequately represent the weed community when it was sampled at rice heading.

INTRODUCTION

For a comprehensive understanding about competition between rice and weeds, weeds should be sampled at the correct stage of crop growth. For a mixed weed vegetation, Kim and Moody(1980) recommended that if weeds are to be sampled only once, they should be sampled at rice heading to obtain the maximum floristic information. IRRI (1978) reported that correlations between crop yield and weed weight were almost always the highest when data were collected at rice flowering.

A community is rarely homogeneous through as to the number of species and their distribution. If there was no variation, a single relatively small sample would always be sufficient. Since variation is the rule, it becomes necessary to have samples large enough or numerous enough to include the variation and to have it fairly represented in the data. Thus, there is always a question of how large and how numerous the quadrates should be for adequate sampling.

Usually all the members of an entire community cannot be counted or measured, and even if this was done, the information would be no more useful or significant than an adequate set of data acquired by proper sampling. Therefore, it becomes of prime importance to determine what constitutes an adequate sample in terms of the community as a whole and how to obtain such a sample with a minimum of effort.

Weed data are generally very variable and the variation in addition to being inherent are due to edaphic and biological factors. When comparing different types of plant associations or communities it is desirable that a suitable area or quadrat be used. This can be determined by the "species-area curve"

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which was originally used to determine the "minimal-area" of a plant community i.e. the smallest area on which the community can develop its characteristic composition and structure. This minimal area is the proper size of the entire stand which represents the community type. The term quadrat, implies a square, and this shape has been more commonly used by ecologists as a sampling unit than any other. Raunkiaer(1934) claimed that the use of a square is probably a matter of habit, for other shapes are just as usable and sometimes more efficient. It is generally accepted that rectangular units are significantly more efficient than squares of equal area, since they tend to include a better representation of the variation in a stand. Clapham(1932) reported that for low vegetation, a plot size of 0.25m x 4m was the most efficient and to secure the same amount of information with squares nearly twice as large an area would have to be observed. Short strips(1:4) gave less variable data than squares but more variable data than long strips(1:16).

To our knowledge only one previous study has been conducted to determine the minimum sampling area and the minimum number of quadrates for weed research in transplanted rice. IRRI(1977) reported that in the Philippines a sampling unit size of between 0.16 and 0.20m^2 seemed appropriate for determining weed density and weed biomass in transplanted rice. An 0.16m^2 quadrat with a sample size of three units per plot resulted in plot values with standard errors of 41, 80 and 42% for weight of broadleaf weeds, grasses and sedges respectively and of 30, 49 and 36% for weed densities.

This study was conducted to determine the minimum quadrat size and minimum number of quadrats for weed sampling in transplanted rice in Korea.

MATERIAIS AND METHODS

The experiment was conducted at the experimental farm of the Yeongnam Crop Experiment Station in 1980. The field was ploughed twice, before and after winter, and harrowed once just before rice transplanting to level the field and incorporate the basal fertilizer does. One hundred and fifty kgN/ha was applied in three splits. Ninety kg N/ha was applied prior to transplanting and 30kg N/ha was top dressed at miximum tillering and again at panicle formation stage. One hundred kg P_2O_5/ha and 100kg K_2O/ha were applied and incorporated prior to transplanting. To ensure sufficient weeds for sampling, the field was not weeded. The weeds were sampled at rice heading because the floristic composition of the transplanted rice field was distinct at that time.

Species-area or quadrat number curves were used to determine the minimum sampling area and the minimum quadrat number required to adequately represent the weed community. For the species-area relationship, six quadrats each 2m x 1m were placed at random and subdivided into successively smaller quadrats ranging from 1m^2 to 0.0625m^2 in size(Fig. 1). The number of species in each increasing sized quadrat was recorded and tabulated. Graphs were than drawn with the number or the size of the quadrats plotted on the X axis and the corresponding number of species on the Y axis.

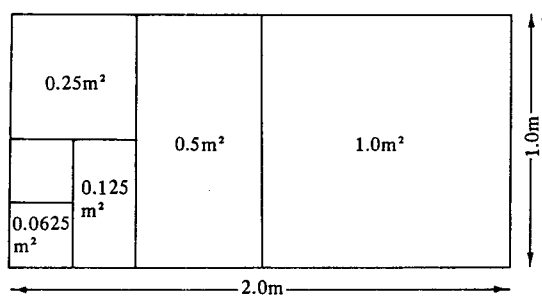

Fig. 1. Method used for determining minimum quadrat size and minimum number of quadrats. YCES, 1980.

When the points are joined the curve first rises abruptly, because many species occur in the first samples, up to a point after which the curve becomes almost horizontal as fewer species are added with increased sampling. The main difficulty is finding the position of the point where the curve

becomes horizontal. The form of the curve obtained depends on the ratio of the X and Y axes.

Cain(1938) suggested using the point on the curve at which an increase in 10% of the total sample area yielded additional species equal to 10% of the total present. This point is located mechanically on the curve. A line is drawn through zero on the graph and the plotted point representing 10% of the species and 10% of the total sample area or 10% of the total quadrat number. Then, a line parallel to the first and tangential to the curve will have to 10% relationship centered at the point where the trngent touches the curve regardless of the form of the curve.

RESULTS AND DISCUSSION

The major weeds in the experimental field were *Monochoria vaginalis*(Burm.f) Presl., *Ludwigia prostrata* Roxb, *Sagittaria pygmaea* Miq., *S. trifolia* L., *Eleocharis kuroguwai* Ohwi, *Cyperus serotinus* Rottb. and *Scirpus hotarui* Ohwi.

When the points were joined in the species-area realationship, the characteristic curve that first rises abruptly and then levels off as fewer species are added with increased sampling size was obtained (Fig. 2). Since the break in the curve represents the point beyond which added sampling effort yields diminishing returns, the need for information about the added species must be weighed against the extra effort in obtaining it. Sampling is adequate when a 10% increase in the total area yields additional species equal to 10% of the total number of species(Cain, 1938; Oosting, 1956). Using this information, in order to adequately sample the community, a quadrat size of $0.32m^2$ was needed. This is considerably larger than the sampling unit size of between 0.16 and $0.20m^2$ required for determining weed density and weed biomass in transplanted rice in the Philippines(IRRI, 1977).

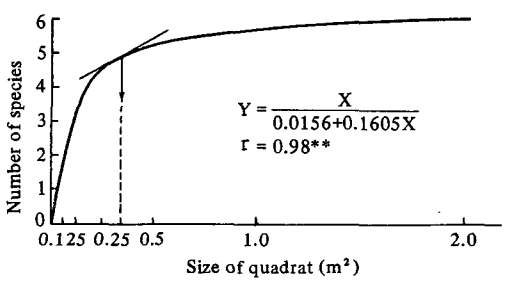

Fig. 2. Relationship between number of species and size of quadrat. YCES, 1980.

The size of the quadrat used for determining the minimum number of quadrats was $0.3m^2$(0.5m x 0.6m) which was more convenient to use than an $0.32m^2$ quadrat. Even though this is slightly unsatisfactory from the standpoint of the 10% relationship, this can be compensated for by increasing the sampling number.

Using the same technique as for the species-area curve, the increase in the number of weed species was plotted against the number of quadrats to determine the minimum number of quadrats. For a 10% relationship 2.7 quadrats were needed (Fig. 3). Thus the minimum size of sampling unit needed to adequately sample the weed flora was $0.864m^2$ (0.32 m x 2.7 m). This can be satisfied by using three quadrats each $0.3m^2$ in area.

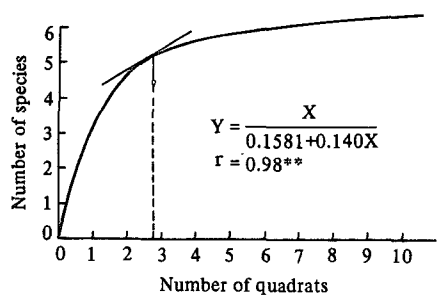

Fig. 3. Relationship between number of species and number of quadrats YCES, 1980.

Therefore, for transplanted rice fields having a similar weed flora to that observed in this experiment the weeds should be sampled three times using an $0.3m^2$ quadrat to adequately represent the flora. However, the minimum quadrat size and the minimum number of quadrats will depend upon the homogeneity of weed distibution and will vary depending upon the distribution pattern of the weed species. Therefore, further studies are needed using different weed community types so that a

suitable sampling technique for a range of weed communities can be recommended.

摘　　要

벼 移秧後에 發生되는 雜草를 調査하여 벼와의 競爭的 影響을 解析함에 있어 가장 적은 努力으로 全體雜草發生狀態를 代表할 수 있는 最少標本크기(minium quadrat size)와 最少標本回數(minimun quadrat number)를 草種－標本面積(species-area) 및 草種－標本回數(species-quadart number) 關係式에 依해 調査하였다.

1. 草種－標本面積, 또는 草種－標本回數 關係式에서 다같이 標本面積, 또는 標本回數가 增加하게 됨에 따라 얻어지는 草種增加는 처음에는 急速度로 增加하고, 徐徐히 增加速度가 緩慢해지며, 어느 限界點을 지나면 더 以上의 草種增加는 없이 平衡狀態를 維持하는 特徵的인 曲線을 보였다.

2. 標本抽出面積, 또는 標本 抽出回數를 10% 增加시킴에 따라 얻어지는 草種 增加率이 10%되는 關係를 顧慮한 最少標本抽出面積은 0.3 ㎡(0.5 m×0.6 m)였고, 最少標本抽出 回數는 3回였다.

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