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SAMPLING TECHNIQUE FOR ESTIMATING SOME QUANTITATIVE CHARACTERS OF TRANSPLANTED RICE

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Abstract

The study was undertaken to determine suitable sampling technique for the estimates of number of panicles and average panicle length/hill, number of filled and unfilled grains/panicle, grain weight/hill, grain weight/panicle, and 1000 grain weight. A population of size 324 hills (18 rows and 18 columns) were considered and the sample of sizes 6, 9, 12, 18, 27, 36, 81, 108 and 162 were generated from this population. The coefficient of variation (CV) of the sample mean for each of these sample sizes were determined for both simple random sampling (SRS) and systematic sampling (SYS). From the comparison of SRS and SYS, it was observed that SRS is more precise than SYS. The sample size for estimating each of the above plant characters was computed by $n=n_0/\{1+(n_0/N)\}$, where n_0 is a first approximation and N is the population size. The effect of population size on the sample size was examined by considering the population of size 36, 81, 108, 162 and 324 hills. The estimated sample size varied from character to character but for the same plant character, the sample size except for very small population, remained more or less the same. The sample sizes that seem to be adequate to have reliable (at 10% margin of error) estimates of the characters under study were determined to be 40 for no. of panicles and grain weight/hill, 25 for no. of unfilled garin/panicle, 15 for no. of filled grain and grain weight/panicle, 2 for average panicle length and 1000 grain weight.

Key words : Population, Sample, Sampling Technique and Sample size.

Introduction

The type of sampling and the size of sample (no. of hills to be selected) to have reliable estimates of rice plant characters is always a question to the researcher.

Rao *et al.* (1975) suggested simple random sampling (SRS) to be more efficient than cluster sampling for plant height and ear bearing tillers. Panse and Sukhatme (1954) suggested sub-sampling procedure with huge

populations where simple random sampling is not practicable. Random plants and plants systematically taken along the rows gave the same mean and variance, indicating the lack of any systematic trend along the rows (Abraham and Mohanty, 1955).

Theoretically, it is known that systematic sampling is precise where units within the same sample are heterogeneous and imprecise when they are homogeneous. Keeping this in mind, only systematic and simple random sampling have been considered in this study to see whether systematic sampling is better than simple random sampling for estimating rice plant characters and to determine appropriate sample sizes (no. of hills to be selected) for different characters.

Materials and Method

The study was based on uniformity trial conducted in T. Aman season, 1982 and 1991. The objectives of the study were to evaluate the precision of simple random sampling (SRS) and systematic sampling (SYS) and to determine a suitable sample size for reliable estimates of some quantitative characters of transplanted rice. The characters considered were : Number of panicles /hill, Average panicle length/ hill, Number of filled grains/panicle, Number of unfilled grains/panicle, Grain weight/hill, Grain weight/panicle, and 1000 grain weight.

In 1982 two varieties, BR4 and BR11, were used and in 1991 the variety used was BR22. The varieties were planted in a large field with a spacing of 20 x 20 cm. The fields were fertilized with recommended rates. Plant protection measures were taken and the field was irrigated as and when required. At the maturity of the crop, an area of 18 hills x 18 hills (324 hills) were randomly selected from the field excluding the border hills. For sampling purpose, the hills were given serial number from 1 to 324 consecutively from one randomly selected corner. At the time of harvest, panicles of each hill were harvested and packed in paper bags separately. Care was taken so that no spikelet dropped from the panicles. Then in the laboratory, every desired character was measured/recorded for each panicle of the sample hills.

For convenience of drawing systematic sample, the sample sizes were considered as 6, 9,12, 18, 27, 36, 81, 108 and 162 since the sample size must be a divisor of population size of 324. For each of these sample sizes, the coefficient of variation (CV) of the sample mean was determined as an indicator of precision of the estimate. For each character and for each sampling technique the relationship between CV and sample size was established by evaluating different models.

Results and Discussion

The population mean, variance and CV(%) for different characters were shown in Table 1. It was found that although the variability in the plant characters varied from character to character the nature of variation for each character was quite similar for different varieties as indicated by coefficient of variation. The average panicle length/hill and 1000-grain weight resulted samller CV(6% to 10%) indicating that the populations of these characters were reasonably homogeneous. The highest CV was observed for grain weight/hill ranging from 35% to 40% followed by no. of panicles/hill ranging from 29% to 34%. The relationship between CV and sample size was obtained as:

$$Y = aX^b$$

where Y = Coefficient of Variation (CV)
X = Sample size
a,b = Constants

The relationships comparing the precision of systematic and simple random sampling are

Table 1. Population mean, variance and CV(%) for different characters of rice plant of BR4, BR11 and BR22.

Characters	BR4 (1982)			BR11 (1982)			BR22 (1991)		
	Mean	Variance	CV(%)	Mean	Variance	CV(%)	Mean	Variance	CV(%)
No. of Panicles/hill	8.43	7.84	33.0	8.25	7.69	34.0	8.55	6.23	29.0
Av. panicle length/hill	22.75	3.36	8.0	23.48	1.87	6.0	26.45	2.23	6.0
No. of filled grains/panicle	103.42	614.41	24.0	99.58	382.72	20.0	105.12	395.64	19.0
No. of unfilled grains/panicle	38.12	93.16	25.0	45.01	112.01	24.0	42.85	118.35	25.0
Grain weight/hills	18.24	53.46	40.0	20.84	65.12	39.0	17.68	37.17	35.0
Grain weight/panicle	2.20	0.28	24.0	2.52	0.26	20.0	2.06	0.16	19.0
100 grain weight	20.70	0.30	8.0	25.10	0.70	10.0	19.70	1.50	6.0

shown in Fig.1. Except for unfilled grain/panicle for BR4, the CV for simple random sampling was smaller than that of systematic sampling in all cases indicating that simple random sampling was more precise than systematic sampling. Moreover, the selection of

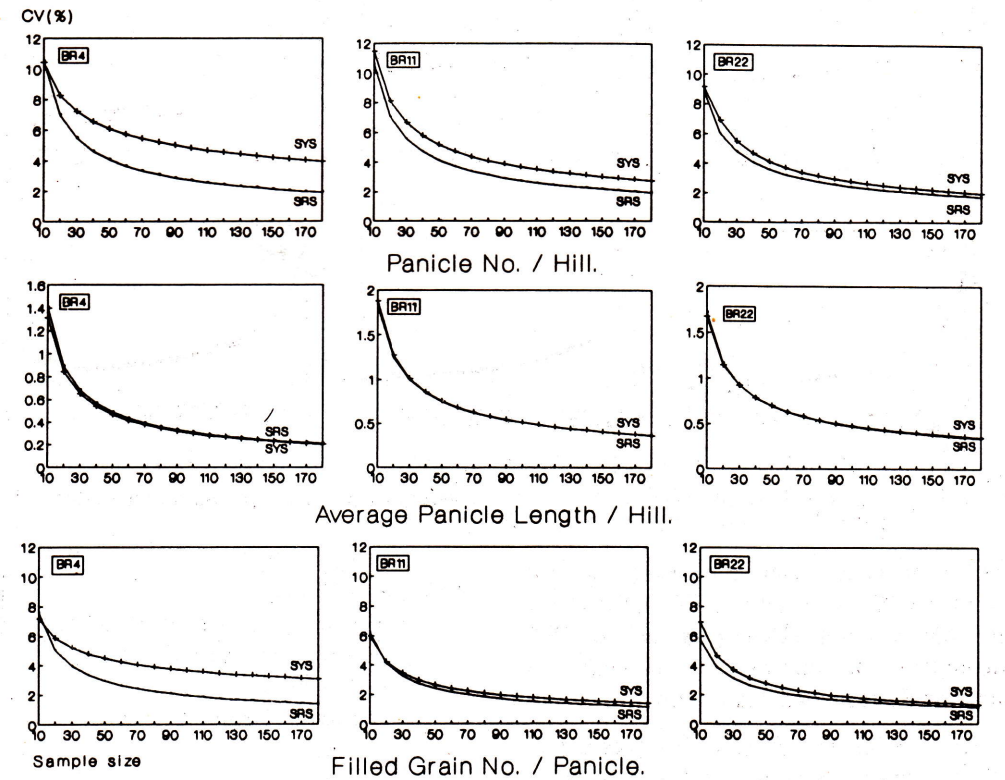

Figure 1. Relationship between sample size and CV(%) of sample mean for systematic & simple random sampling (SYS & SRS)

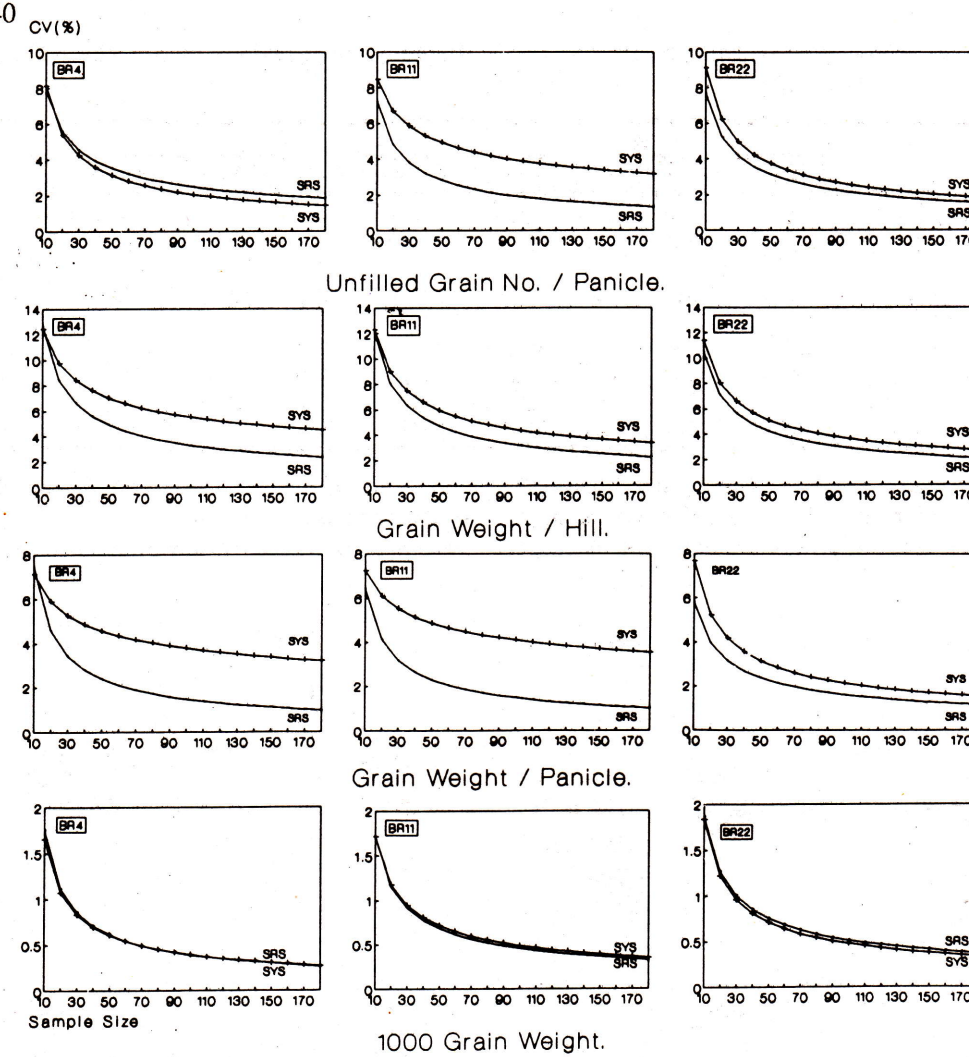

Figure 1. (Contd.): Relationship between sample size and CV (%) of sample mean for systematic & simple random sampling (SYS & SRS).

sampling units and estimation procedure are easier for SRS compared to SYS. It, therefore, seems obvious that SRS is preferable to SYS both in terms of precision and simplicity for estimating the characters under study.

Since, SRS was found to be superior to SYS, the sample size for each of the plant characters was determined by (Chocharan, 1967)

$$n = n_o / \{1+(n_o / N)\}$$

where $n_o = t^2 S^2 / d^2$

t = value of standard normal variate at 50% probability level (level of risk).

S^2 = Population Variance

d = margin of error = 10% of population mean

To study the effect of population size on the sample size, the sample sizes at 10% margin of error were determined for the populations of

Table 2. Estimated sample sizes at 10% margin of error for differnt plant characters under varying population sizes, BR22, 1991.

Population sizes	Sample sizes for						
	No. of panicles /hill	Av. Panicle length/ hill	No. of filled grains/ panicle	No. of unfilled grains/ panicle	Grain wt. /hill	Grain wt. /panicle	1000 grain weight
36	12	1	9	11	14	9	1
64	19	1	10	13	25	11	1
100	25	1	10	15	31	11	1
144	27	1	10	18	32	11	1
196	29	1	11	19	37	11	2
256	29	1	12	20	38	12	2
324	30	1	13	23	40	14	2

36 (6x6 hills), 64 (8x8 hills), 100 (10x10 hills), 144 (12x12 hills), 196 (14x14 hills), 256 (16x16 hills) hills constructed from the population of 324 (18x18 hills) hills and those also for the population of 324 hills and the results are presented in table 2. It was observed that except for very small population, the sample size did not vary much with the increase of population size. For the population of 100 hills or more, the sample size for panicles/hill varied from 25-30 hills. These figures for filled grain/panicle, unfilled grain/panicle, grain weight/hill, grain weight/panicle were 10-13, 15-23, 31-40, 11-14 hills, respectively, and for average panicle length and 1000-grain weight it was 1-2 hills. Results clearly indicated that a single sample size should not be used for all plant characters. Since, from the practical point of operation and estimation, too many sample sizes for the same experiment are not desired, a compromise seems to be essential. It seems clear that the seven characters under study can be placed in four groups in terms of sample size : no. of panicles and grain weight/hill in group 1, no. of filled grains and grain weight/panicle in group 2, no. of unfilled grains/panicle in group 3 and average panicle length and 1000 grain weight in group 4. Group 1 characters will need largest no. of hills for their estimation from the field and the group 4 characters will need the least no. of hills. From the results, it seems quite reasonable that a sample size of 40 hills was adequate for group 1 character and that for group 2, 3 and 4 were 15, 25 and 2 respectively.

Conclusion

From the above discussion it may be concluded that for estimating different quantitative characters of transplanted rice plants, (i) simple random sampling for selecting hills is preferable to systematic sampling and (ii) the sample sizes (no. of hills to be selected) for different plant characters are : 40 for no. of panicles and grain weight/hill, 25 for no. of unfilled grain/panicle, 15 for no. of filled grain and grain weight /panicle and 2 for average panicle length & 1000 grain weight.

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