

ESTIMATION OF THE OPTIMUM PLANT SAMPLE SIZE FOR YIELD AND ITS COMPONENTS IN LENTIL

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Abstract

Two experiments were conducted at Giza and Sids Research Stations in 1999/2000 season, to determine the optimum plant sample size for yield and its components and morphological characters in lentil. Five plant sample sizes (10, 20, 30, 40 and 50 plants/plot) with the whole plant-plot population were used with the new lentil varieties Giza 4 and Giza 51. Results indicated that the characters, which had high variation, needed large sample size. The optimum plant sample size was found to be 20-30 plants to estimate seed yield/plant, 30 plants for number of pods and seeds/plant, 10 plants for plant height and number of branches/plant. Biological and straw yield/plant were not accurately estimated from samples and they should be estimated from whole plots. Similar trend for sample size was obtained in both varieties in most studied characters, which exhibited significant location x sample size interaction. Therefore, further studies should be carried out in various locations rather than in a single location to remove the location effect.

INTRODUCTION

The sampling in experimental plots is important since plot size for field experiments is usually selected to achieve a prescribed degree of precision for measurement of the character of primary interest, such as yield. Because yield character is difficult to measure, and the required plot size is often larger than that needed to measure other characters. Thus, if the measurements of additional characters are made by sampling a fraction of the whole plot, cost and time can be saved. An appropriate sample is that one which provides an estimate that is as close as possible to the value that would have been obtained if all plants in the plot have been measured.

Determination of optimum plant-sample size in lentil is important since the information from previous studies showed non-logical weak correlations between seed yield and yield components characters, which ranged from 0.02 to 0.56 (Muehlbour, 1984

Kumar *et al.*, 1983; Esmail *et al.*, 1994; Selim, 2000). The low correlations between seed yield and its component characters in lentil were mainly due to small sample sizes (ranging from 5-10 plants/sample) that were used to measure such characters. For example, correlation values between seed yield and number of pods/plant were reported as 0.25 (Muehlbauer, 1974), 0.15 (Kumar *et al.*, 1983) and 0.19 (Selim, 2000) when 5-10 individual plants have been used as sample size. But, the correlation value between number of pods and seed yield was high and recorded 0.71 (Hamdi *et al.*, 1991a) when number of pods/plant was estimated from the whole plot plants.

The optimum plant sample size in lentil has been determined by El-Attar (1991). He found that 20 plants is the optimum sample to represent seed yield and 40 plants is the optimum sample for number of seeds/plant and 100-seed weight. He noted that future studies should emphasize the effect of sample size on growth characters. Nasr and El-Hady (1998) mentioned that the characters with high variation between plants need relatively larger plant samples than those with low variation in faba bean. The present investigation aimed to determine the optimum plant sample for yield and its components and morphological characters in lentil.

MATERIALS AND METHODS

This study was conducted at Giza and Sids Research Stations, to compare between five plant sample sizes (10, 20, 30, 40 and 50 plants/plot) and the whole population of plant per plot to determine the optimum plant sample size for measuring different lentil characters. In these experiments the two new released lentil varieties Giza 4 and Giza 51 (Hamdi, 1998) were used with split-plot design, where the varieties were arranged in the main plots and the sample sizes in the sub-plots. Four replicates were used in each experiment with 5.4 m² plot area, at harvesting the borders were discarded and the central 1.2 m² was maintained, then the individual plants were randomly harvested according to the number of plants/sample allocated in each sub-plot, and all the remaining plants in each plot were harvested individually by hand, air dried, weighed, treshed by hand and then the clean seeds weighed. The following characters were estimated from individual plants collected as samples: seed yield/plant, biological yield/plant, straw yield/plant, number of pods/plant, number of seeds/plant, plant height and number of branches/plant. The same characters were estimated from all plants col-

lected in each plot to represent the whole plot population, which considered as a control. Other four characters were estimated on the whole plot basis: days to 50% flowering, days to 90% maturity, number of seeds/pod, and 100-seed weight (g).

Data were subjected to statistical analysis according to Gomez and Gomez (1984). The optimum plant-sample size is that insignificantly differed from the whole plot population.

RESULTS AND DISCUSSION

The combined analysis of variance over locations, varieties and plant sample sizes and their interactions for lentil characters estimated on the basis of individual plants (Table 1) and lentil characters estimated on the whole plant-plot population basis (Table 2) showed significant effect of location on all studied characters, except number of seeds/pod and days to maturity. The interaction effect of location x variety was significant only in seed yield/plant, number of pods/plant and plant height, while, the effect of sample size was significant in all studied characters, except number of branches/plant (Table 1). The first order interaction of location x sample size (LS) and variety x sample size (VS) and the second order interaction of location x variety x sample size (LVS) were significant in some studied characters as shown in Table (1).

Location and genotype effects:

The high magnitude of mean square of location effect for various characters indicating the predominant effects of locations on the performance of all lentil characters, except days to 90 % maturity. Performances at Giza was higher for all characters than Sids, except for 100-seed weight. For example, seed yield/plant at Giza was 0.930 g/plant while it was 0.564 g at Sids, giving an increase of 64.9 %. The superiority of lentil characters at Giza may be due to the differences in soil fertility and other environmental conditions between the two sites, suggesting the possibility of increasing yield levels through improved management practices such as soil fertility, fertilization,.. etc. Important location effects on performance of lentil characters were previously reported by many researchers (Pandey *et al.*, 1982; Ahmed and Pandey, 1983; Erskine, 1983; Mohamed *et al.*, 1989; Hamdi *et al.*, 1991a; Hamdi *et al.*, 1991b; Hamdi and Rabeia, 1991 and Hamdi *et al.*, 1992).

Table 5. Average of number of of pods/plant and seeds/plant for five sample sizes comparing with the whole plot plants of Giza 4 and Giza 51 grown at Giza and Sids Research Stations and their combined data in 1999/2000 season.

Variety Location	Sample size for (number of plants)					Whole plot plants
	10	20	30	40	50	
Giza						
Giza 4	35.200 ^{AB}	36.675 ^A	28.300 ^C	29.075 ^{BC}	38.300 ^A	23.900 ^C
Giza 51	39.757 ^A	40.700 ^A	38.200 ^A	38.925 ^A	42.800 ^A	31.950 ^B
Sids						
Giza 4	8.175 ^C	9.675 ^{BC}	11.625 ^B	15.757 ^A	11.500 ^B	9.575 ^{BC}
Giza 51	21.675 ^{ABC}	27.375 ^A	16.575 ^C	26.825 ^{AB}	23.400 ^{ABC}	20.400 ^{BC}
Combined						
Giza station	37.388 ^{AB}	38.688 ^A	33.250 ^B	34.000 ^B	40.550 ^A	27.925 ^C
Sids station	14.925 ^C	18.525 ^{AB}	14.100 ^C	21.200 ^A	17.450 ^{BC}	14.988 ^C
Overall	26.156 ^{BC}	28.606 ^{AB}	23.675 ^{CD}	27.600 ^{AB}	29.000 ^A	21.456 ^D

Variety Location	Sample size for no. of seeds/plant					Whole plot plants
	10	20	30	40	50	
Giza						
Giza 4	51.325 ^{AB}	48.300 ^{AB}	38.375 ^B	40.675 ^{AB}	53.475 ^A	37.775 ^B
Giza 51	47.275 ^{AB}	47.300 ^{AB}	43.600 ^B	51.350 ^{AB}	56.175 ^A	48.200 ^{AB}
Sids						
Giza 4	20.775 ^{AB}	28.400 ^A	29.075 ^A	23.925 ^{AB}	19.575 ^{BC}	15.900 ^C
Giza 51	43.225 ^A	40.025 ^A	25.100 ^B	39.475 ^A	31.875 ^{AB}	31.225 ^{AB}
Combined						
Giza station	49.300 ^{AB}	47.800 ^{AB}	40.987 ^B	46.013 ^{AB}	54.825 ^A	42.987 ^B
Sids station	32.000 ^{AB}	34.213 ^A	27.088 ^{BC}	31.700 ^{AB}	25.725 ^{BC}	23.563 ^C
Overall	40.650 ^A	41.006 ^A	34.038 ^{BC}	38.856 ^{AB}	40.275 ^A	33.275 ^C

Means not followed by the same letter are significantly different at 0.05 level.

Table 6. Average of plant height (cm) and no. of branches/plant for five sample sizes comparing with the whole plot plants of Giza 4 and Giza 51 grown at Giza and Sids Research Stations and their combined data in 1999/200 season.

Variety Location	Sample size for plant height					Whole plot plants
	10	20	30	40	50	
Giza						
Giza 4	55.300 ^A	56.125 ^A	56.950 ^A	58.450 ^A	55.725 ^A	56.550 ^A
Giza 51	51.350 ^A	50.475 ^A	50.275 ^A	48.200 ^A	47.300 ^A	49.525 ^A
Sids						
Giza 4	50.925 ^A	46.625 ^A	48.025 ^A	48.500 ^A	47.975 ^A	48.400 ^A
Giza 51	52.600 ^A	46.775 ^{BC}	48.125 ^{AB}	48.575 ^{AB}	42.225 ^C	47.650 ^{AB}
Combined						
Giza station	53.325 ^A	53.300 ^A	53.613 ^A	53.325 ^A	51.513 ^A	53.038 ^A
Sids station	51.763 ^A	46.700 ^B	48.075 ^B	48.538 ^{AB}	45.100 ^B	48.025 ^B
Overall	52.544 ^A	50.000 ^{BC}	50.844 ^{AB}	50.931 ^{AB}	48.306 ^C	50.531 ^{ABC}

Variety Location	Sample size for branches/plant					Whole plot plants
	10	20	30	40	50	
Giza						
Giza 4	5.650 ^A	6.550 ^A	5.525 ^A	4.000 ^B	6.100 ^A	5.550 ^A
Giza 51	7.800 ^A	7.350 ^A	5.575 ^A	8.350 ^A	7.025 ^A	7.250 ^A
Sids						
Giza 4	2.905 ^A	3.300 ^A	2.780 ^A	3.600 ^A	3.150 ^A	3.150 ^A
Giza 51	3.750 ^B	4.600 ^{AB}	4.200 ^{AB}	5.325 ^A	4.625 ^{AB}	4.475 ^{AB}
Combined						
Giza station	6.725 ^A	6.950 ^A	5.550 ^A	6.175 ^A	6.562 ^A	6.400 ^A
Sids station	3.327 ^B	3.950 ^{AB}	3.490 ^{AB}	4.462 ^A	3.888 ^{AB}	3.812 ^{AB}
Overall	5.026 ^{AB}	5.450 ^A	4.520 ^B	5.319 ^{AB}	5.225 ^{AB}	5.106 ^{AB}

Means not followed by the same letter are significantly different at 0.05 level.

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تقدير أنسب حجم للعينة النباتية لتقدير كمية المحصول ومكوناته فى العدس

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أقيمت تجربتان بمحطتى البحوث الزراعية بكل من الجيزة وسدس فى موسم ١٩٩٩/٢٠٠٠ لدراسة أنسب حجم للعينة النباتية لصفات محصول البذور للنبات الفردى، المحصول البيولوجى، محصول التبن/نبات، عدد القرون/نبات، عدد البذور/نبات، طول النبات وعدد الفروع للنبات، وقد تم دراسة خمسة أحجام للعينة وهي ١٠، ٢٠، ٣٠، ٤٠، ٥٠ نبات مقارنة مع كل نباتات القطعة التجريبية وذلك على الصنفين الجديدين للعدس جيزة ٤، جيزة ٥١. وقد أشارت النتائج إلى أن الصفات ذات التباين العالى تحتاج إلى حجم عينة أكبر لتقديرها من ذات التباين المنخفض.

أظهرت النتائج أن أنسب عدد لنباتات العينة هو ٢٠-٣٠ نبات لصفة محصول البذور للنبات، ٣٠ نبات لصفة عدد القرون وعدد البذور للنبات، و ١٠ نباتات لصفة طول النبات وعدد الفروع، بينما يصعب قياس صفة المحصول البيولوجى ومحصول التبن للنبات بواسطة النباتات الفردية وإنما يجب قياسها من كل نباتات القطعة التجريبية، وقد أظهر الصنفان سلوكاً متشابهها فى أغلب الصفات المدروسة، كما أظهرت النتائج وجود تأثيراً معنوياً للتفاعل بين الجهة وحجم العينة ولذلك فإن أى دراسة لحجم العينة فى العدس يجب أن تقام فى أكثر من جهة وذلك لاستبعاد تأثير الجهات.