SPATIAL VARIABILITY OF PHYSICAL, CHEMICAL, AND PHYSIOLOGICAL PARAMETERS RELATED TO SUNFLOWER YIELD

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SUMMARY- The study illustrate the use of semivariograms and autocorrelograms as tools to forecast spatial dependance of parameters that influence sunflower yield at different types of soils. The measurements were made in 3 different types of soil groups of Sao Paulo State, Brazil, at the nodes of a regular grid consisting of 75 points. All the parameters were submitted to correlation studies and only wich that presented variation coefficient < 20% and correlation coefficient significant at 1% level were selected for geoestatistical analysis. Head diameter showed good correlation with stem diameter, crop yield, oil yield, and total dry matter.

Key words: spatial variability, crop yield, sunflower, correlation.

INTRODUCTION-

Unfavorable soil conditions can negatively influence sunflower culture stablishment (germination and emergence of the seedlings), development and production (HERNANDEZ & ORIOLI, 1985).Some studies of correlation between physiological characteristics of sunflower plants has been done by several authors. CADEAC (1988) found a high correlation value between stem and head diameter, wich was dependent of climatic conditions, and a good correlation between stem diameter and plant height. Unfortunately the authors did not include the association between physiological parameters of plant with chemical and physical soil parameters.

BALL & WILLIAMS (1968), studying the variability of chemical properties of non-cultivated soils, found for many parameters, a variation coefficient of about 33% wich lead them to conclude that in any pedologycal and ecological study is important to consider the spatial variability quantitatively, in order to better understand the observed values.

MATERIAL AND METHODS

The experiments were carried out in 3 different soil groups with different agricultural potential, located in Jundiai, Mococa and Ribeirao Preto Experimental Stations of Agronomic Institute of Sao Paulo State, Brazil. The hybrid DK-180 was planted in Mococa and Ribeirao Preto, and an open-pollinated variety was used in Jundiai. The measurements were made at the nodes of a regular grid consisting of 75 points with 5m intervals between them. The soil samplings for chemical and physical analysis were done soon after the sowing date in each point.

The plants located in 1m of the 2 rows near the sampling point were harvested at the end of flowering period. Number of plants/area (STD), stem diameter(SD), head diameter (HD), plant height(AP), crop yield(Y), oil yield(OY), and dry matter(DM) were measured for each point. The data analysis were based on frequency distribution and dispersion in each place. All the parameters were also submited to correlation studies to avaliate the functional relationships between them. The selection of parameters was based on the

variation coefficient (CV <20%) and correlation coefficient significant at 1% level (t <0.01). Achene and oil yield were always considered.

The selected parameters were submited to geoestatistical analysis in order to characterize the behaviour of the plant populations in each place through the use of semivariograms.

RESULTS AND DISCUSSION

Informations about the obtained data of chemical and physiological parameters are shown in Table 1. The great variability in the chemical data suggests future problems for liming and fertilizer procedures. Otherwise, the low correlation between sunflower yield components and chemical soil parameters, like P and K, should be an indication that the sowing fertilization (400kg/ha of 4-20-20) was adequated for normal growth and that some other factors should be responsible for the observed differences between the samples. The open-pollinated variety showed a wide variation in the physiological parameters wich indicates problem with agricultural procedures like harvest and dry matter management. In the other places, unless was used a simple hybrid, the observed data had a variation wide enough to cause the same problems with the machinery.

Figure 1 shows the influence of extrem values in the frequency distributions. In Jundiai, that presents a wide base saturation variation, the media was dislocated to classes with low V% (Fig.1A). In Mococa (Fig.1B) the distribution was concentrated around 70%, wich represents the media and showed no correlation between crop yield, pH and V%. This lack of correlation was expected as the lowest base saturation value was 53% and pH value was 5.5, high enough not to have great influence over the crop yield components, as discussed by QUAGGIO et al.(1985).

Table 2 shows the correlation coefficients between the selected parameters. Plant height presented a significant correlation with stem diameter in the 3 soil types. Number of plants/ha was correlated to crop yield, oil yield and head diameter in 2 soil types. Head diameter showed good correlation with stem diameter, crop yield, dry matter, and oil yield.

Figure 2 shows the spatial dependance for all directions. The autocorrelogram goes down slowly, indicating a long distance dependance for V%. In Jundiai, the spatial dependance is less than 10m, indicating a high soil variability for this parameter, while in Mococa it was 20m and in Ribeirao Preto was about 23m, wich reflects less soil variability for V% in these soils.

Figure 3 represents the spatial variability for sunflower achene yield in Jundiai.

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Table 1: Variation of soil chemical and physiological parameters in 3 soil types.

Parameters	Soil types		
	Jundiaí	Ribeirão Preto	Mococa
P(mg/cm^3)	1,0-13,1	20,0-70,0	22,0-80,0
OM(%)	1,8-4,1	2,3-3,9	1,3-2,0
pH($CaCL_2$)	4,6-5,9	4,6-5,4	5,5-6,4
K($meq/100cm^3$)	0,02-0,60	0,03-0,52	0,10-0,38
Ca($meq/100cm^3$)	0,9-4,1	1,0-3,7	2,2-3,7
Mg($meq/100cm^3$)	0,6-1,9	0,6-1,6	0,9-1,9
V(%)	32-76	27-62	53-77
AP(cm)	164,7-258,8	146,1-188,3	162,2-207,5
SDcm)	13,2-30,7	14,2-26,1	16,2-25,0
DM(kg/ha)	650-5400	650-6050	1800-6200
STD(pl./ha)	27174-59783	27174-65217	38043-54348
Y(kg/ha)	875-3826	769-2830	1005-2935
HD(cm)	11.0-21.0	9.7-17.5	12.2-19.4
OY(kg/ha)	356-1454	323-1185	420-1175

Table 2: Linear correlation coefficients significant at 1% level,in the 3 soil types(Jundiai, Mococa, and Ribeirao Preto).

Place	Analysed Parameters									
	STD	AP	HD	SD	Y	OY	V%	DM	pH	Ca
Jundiaí										
STD	-	-	-	-	0.49	0.44	-	-	-	-
AP	-	-	-	0.89	-	-	0.51	-	0.54	-
HD	-	-	-	0.31	0.50	0.49	-	0.51	-	-
SD	-	0.89	0.31	-	0.35	0.33	0.40	0.32	0.45	
Y	0.49	-	0.50	0.43	-	0.96	-	0.81	-	-
DM	-	-	0.51	0.32	0.81	0.89	-	-	-	-
OM	-	0.38	-	0.43	-	-	0.40	-	0.52	
Rib. Preto										
STD	-	-	0.36	-	0.61	0.61	-	-	-	
AP	-	-	-	0.43	-	-	-	-	-	-
HD	-	-	-	0.65	0.70	0.70	-	-	-	
SD	-	0.43	0.65	-	-	-	-	-	-	-
Y	0.61	-	0.70	-	-	0.99	-	-	-	-
DM	-	-	0.44	0.44	0.32	0.32	-	-	-	
OM	-	0.32	-	-	-	-	0.55	-	0.36	0.60
Mococa										
AP	-	-	-	0.70	-	-	-	-	-	-
HD	-	-	-	0.52	0.42	0.34	-	0.33	-	
SD	-	0.70	0.52	-	0.42	0.34	-	-	-	
Y	-	-	0.42	0.42	-	0.95	-	-	-	-
DM	-	-	0.33	-	-	-	-	-	-	-
OM	-	-	0.47	-	-	-	-0.35	-	-	-
Ca	-	-	-	-	-	-	0.67	-	0.41	-
Mg	-	-	-	-	-	-	0.72	0.32	0.34	0.86

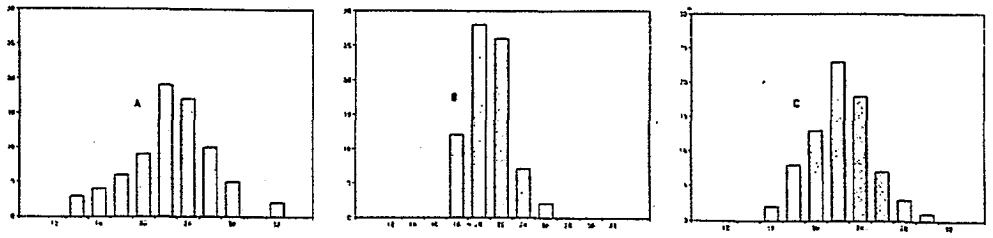

Fig. 1A- Frequency distribution for head diameter in the 3 soil types.
A= Jundiai B= Mococa C= Ribeirao Preto

404

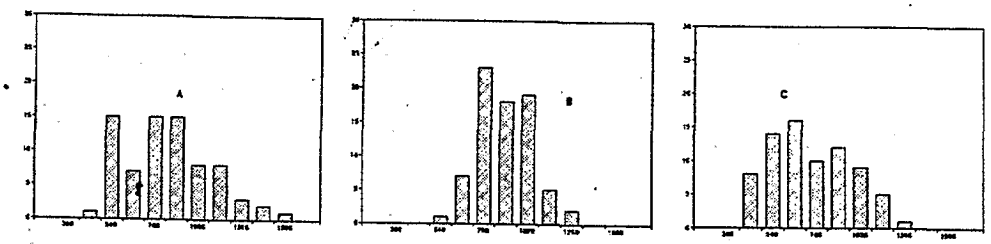

Fig. 1B- Frequency distribution for oil yield in the 3 soil types.

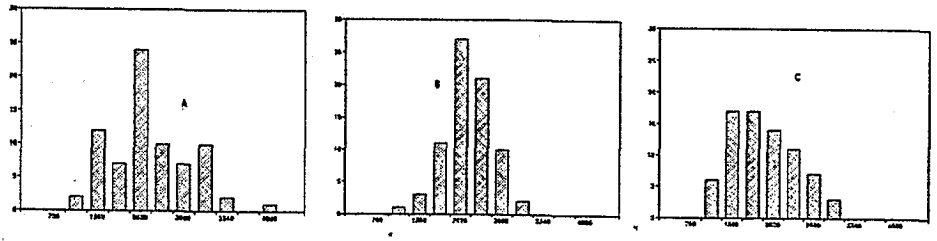

Fig. 1C- Frequency distribution for sunflower yield in the 3 soil types.

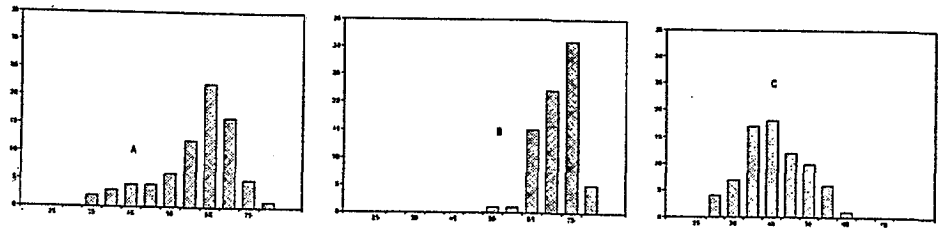

Fig. 1D- Frequency distribution for base saturation in the 3 soil types.

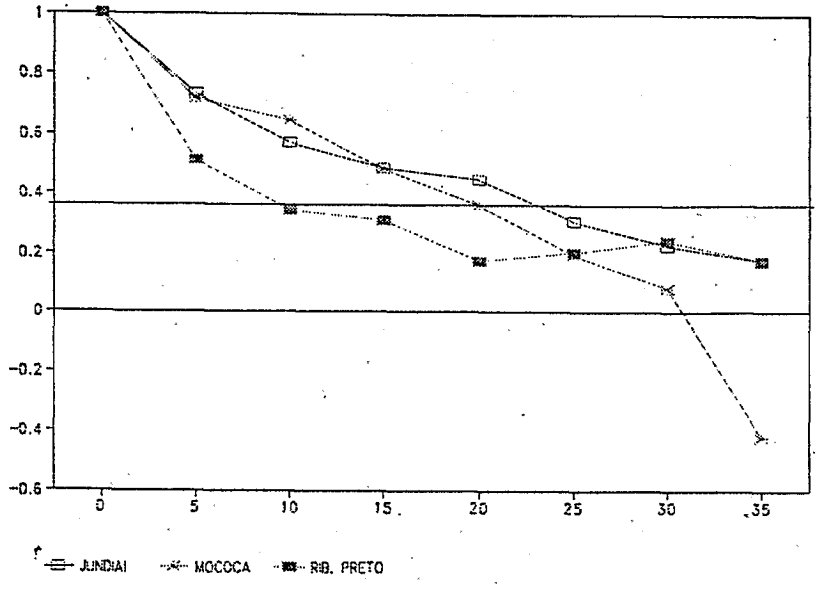

Fig. 2- Autocorrelogram of V% values for the 3 soil types.

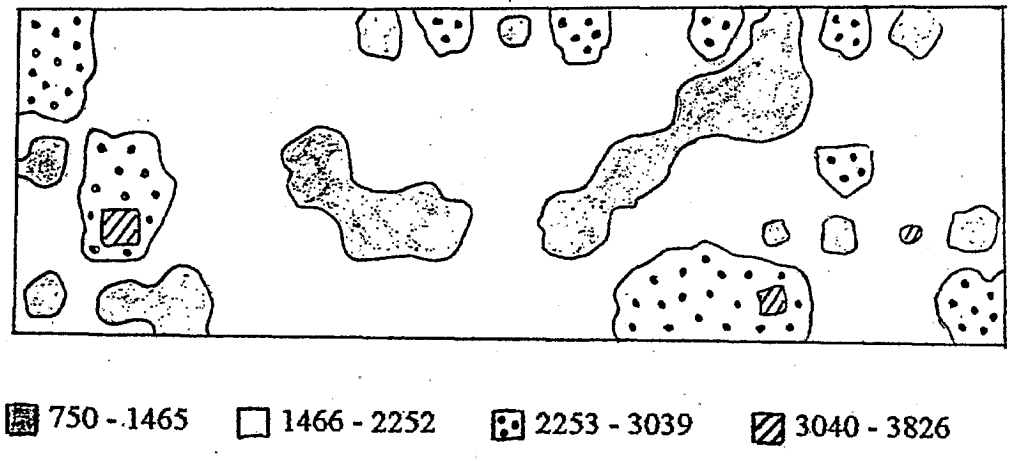

Fig. 3- Diagram of spatial distribution for sunflower yield in Jundiai.