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Gap – A Source of Random Variation in Bidi Tobacco Field Experiments

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ABSTRACT

The results reported herein relating to the effect of gap (missing plant) on yield and yield attributes of bidi tobacco reveal that the gaps as well as their period of occurrence had direct influence on leaf length, leaf width and yield per plant. The sucker weight was influenced by the period of occurrence of the gap only. The yield of tobacco per plant increased with the increase in the number of gaps around it. This study thus indicates the need of adjustment of the treatment estimates for valid comparisons when experimental plots of bidi tobacco become gappy due to extraneous reasons.

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INTRODUCTION

Uniform plant stand per plot is a prime requirement of the field experiment in agriculture, as the random variation in plant stand which may occur due to poor establishment, diseases, pests, mechanical injury, etc. reduces the precision of the estimates of the treatments. Several workers have studied the effect of gap (missing plants) in different crops (Olson, 1928; Brewbaker and Deming, 1935; Arceneaux and Stoke, 1939; Mahoney and Baten, 1939; Leng and Finley, 1957; Crews and Jones, 1962) and devised the methods of adjustment of yield on the basis of plant stand. However, such information is not available for bidi tobacco (*Nicotiana tabacum* L.) The results reported herein relate to the effect of gaps occuring in different pattern at various stages of crop growth on leaf length, leaf width, fresh sucker weight and yield of bidi tobacoo. The field experiment was conducted at the College Farm of the Gujarat Agricultural University, Anand Campus during the year 1975-76.

Experimental :

The experimental area was divided into five blocks of which one was chosen at random for "no gap" treatment i.e. the plant stand was kept 100% in the block. The remaining four blocks were utilized at random for four periods of occurrence of gap viz. 0, 30, 60 and 90 days after transplanting and within each block gaps around the plant (one, two, three and four) were created. Thus there were 17 treatments including "no gap" treatment. The different types of gaps were created by removing the plants as required. Figure 1 exhibits the different pattern of gaps.

The variety Anand 2 was used for this purposes, the spacing adopted being 90 cm x 75 cm. The number of plants available for assessment of gap effect were 660.

Attributes studied :

1. *Leaf length* from petiole base to leaf tip of 1st, 2nd, 7th, 9th and 11th leaf in decending order from top to bottom, of ten randomly selected plants in each treatment was measured at the harvest time.
2. *Leaf width* of the leaves selected for leaf length attribute was measured in the region of maximum expansion at the harvest time.
3. *The weight of fresh suckers* of the plants selected for leaf length observation was recorded upto harvesting time regularly at weekly interval after topping.
4. *Yield* of bidi tobacco comprises four fractions viz. *bhukka* (lamina), *galia* (sand leaves), *rago* (midribs), and *geran* (small bits of lamina and veins which remain attached to midribs while separating lamina from the midribs but get detached on drying). Per plant yield of all the four fractions seperately were recorded and subsequently pooled to arrive at individual plant yield.

Statistical :

The deviation in performance of the plant adjacent to gap(s) as compared to the plant having no gap around it is an indication of the gap effect. In absence of the gap effect, the estimate available would not differ significantly. In the normal field experiments, gaps may occur in net plot due to unknown causes. The gap effect, therefore, is a random effect. But in the present investigation fixed number of gaps, were caused at a fixed period around plant. Therefore gap, period and gap x period

P	P	P	P	P	P	P	P	P	P	P	P
P	P	P	**P**	P	**P**	P	**P**	P	**P**	P	P
P	P	**P**	X	**P**	X	**P**	X	**P**	X	**P**	P
P	P	P	**P**	X	**P**	P	**P**	X	**P**	P	P
P	P	**P**	X	**P**	X	**P**	X	**P**	X	**P**	P
P	**P**	X	**P**	X	**P**	X	**P**	X	**P**	P	P
P	P	**P**	P	**P**	P	**P**	P	**P**	P	P	P
P	P	P	**P**	P	P	**P**	P	P	**P**	P	P
P	P	**P**	X	**P**	**P**	X	**P**	**P**	X	**P**	P
P	**P**	X	**P**	**P**	X	**P**	**P**	X	**P**	P	P
P	P	**P**	X	**P**	**P**	X	**P**	**P**	X	**P**	P
P	P	P	**P**	P	**P**	**P**	**P**	P	**P**	P	P
P	P	**P**	X	**P**	X	**P**	X	**P**	X	**P**	P
P	P	P	**P**	P	**P**	P	**P**	**P**	**P**	P	P
P	P	P	P	P	P	P	P	P	P	P	P

Legend : P = Plant; X = Gap

P = Plant considered for estimating gap effect

Fig. 1. Different patterns of gap

effects were considered as fixed effects. The statistical model used in testing main as well as interaction effects is described below.

$$Y_{ijk}=\mu+G_i+P_j+GP_{ij}+\epsilon_{ijk}$$

Where

μ=Population mean

G_i=the effect due to ith gap

P_j=the effect due to jth period of gap occurrence

GP_{ij}=the interaction effect due to jth period of gap occurrence and ith gap.

ϵ_{ijk} = error associated with kth plant in jth period of gap occurrence in ith gap.

The assumptions are

$$\Sigma G_i=\Sigma P_j=\Sigma GP_{ij}=O$$

$$\epsilon_{ijk} \sim NID\ (O,\sigma^2)$$

Each effect was tested by analysis of variance method.

RESULTS AND DISCUSSION

The data pertaining to average leaf length, leaf width, sucker weight and yield for the gap as well as period of occurrence of the gap along with significant interaction are presented in Table 1 and 2.

TABLE 1

The average length, leaf width, sucker weight and yield as influenced by the type of gap and its period of occurrence.

Treatment	*Leaf length, cm.*	*Leaf width, cm.*	*Sucker weight, g/plant*	*Yield, g/plant*	*Loss or gain due to gap, %*
Control	47.2	17.3	259.3	129.2	—
Gap – G_1	49.7	20.3	257.7	136.5	5.7
G_2	49.2	20.4	266.4	144.1	11.5
G_3	50.7	21.2	261.8	181.8	40.7
G_4	52.0	22.9	271.3	200.1	54.9
S.Em.	0.44	0.33	7.2	3.3	—
C.D. 0.05	1.29	0.95	ns	9.1	—
Period–P_1	49.1	19.9	245.2	139.5	—
P_2	55.3	25.0	261.6	167.2	—
P_3	51.4	22.1	260.6	164.5	—
P_4	45.8	17.7	289.9	154.3	—
S.Em.	0.44	0.33	7.2	3.1	—
C.D. 0.05	1.29	0.95	22.9	8.6	—
Interaction G × P	Sign.	Sign.	ns	ns	—
Control v/s Gap	Sign.	Sign.	ns	Sign.	—

TABLE 2

The average leaf length and leaf width for G × P interaction.

Attribute	Gap	Period of Gap occurrence				S.Em.	C.D. 0.05
		P_1	P_2	P_3	P_4		
Leaf length, cm	G_1	47.4	54.4	50.2	46.8	0.89	2.58
	G_2	49.0	54.5	51.7	41.5		
	G_3	48.2	54.8	51.9	47.8		
	G_4	51.8	57.5	51.8	47.1		
Leaf width, cm	G_1	18.3	24.1	20.9	17.4	0.66	1.90
	G_2	19.6	24.0	22.1	15.7		
	G_3	20.1	24.4	22.3	18.0		
	G_4	21.7	27.4	23.2	19.4		

The leaf length and leaf width data (Table 1) reveal that the differences in leaf length as well as leaf width due to gap and period of occurrence of the gap were significant. The comparison "Control v/s Gap" was also significant for both characters, indicating that the gaps had beneficial effect on leaf attributes. The G_4 had contributed significantly more leaf length and leaf width than G_1, G_2, and G_3. Among the last three, though the differences were nonsignificant, G_3 type contributed more leaf length and leaf width than G_1 and G_2.

The P_2 gave significantly more leaf length (55.3 cm) as well as leaf width (25.0 cm), P_3 being next in order. The trend due to period effect remained same for both the attributes viz. leaf length and leaf width. It is worthwhile mentioning that the period covered by P_2 and P_3 is the most active phase of the crop growth in bidi tobacco (Pundarikakshudu, 1974). During this period the nutrient uptake by the plant is also more. The gap occuring at the time when plant is undergoing maximum cell multiplication for growth might have helped in accelerating this activity and thereby getting more leaf length as well as width. However the P_1 had not shown the similar trend though the plant was already having gap(s) when it went to the most active growth phase. While causing the gaps, the growing plants are uprooted. In the case of later periods, well developed plants are uprooted, which make the plant spot and surrounding area soil loose. This provides a very congenial soil condition for the development of roots of the adjacent plants and thereby the plant growth. This probably is the case with P_2, P_3 and P_4 and explains for the increased plant growth as compared to P_1.

The interaction effect G x P for leaf length as well as leaf width (Table 2) was significant indicating that both these attributes are affected by gap and their period of occurrence. The combination G_4P_2 gave maximum leaf length as well as leaf width, whereas G_2P_4 gave minimum leaf length and leaf width.

The sucker weight (Table 1) was not influenced by gap but the period of occurrence of gap had its influence on this attribute and P_4 gave significantly more sucker weight than P_1, P_2 and P_3 the latter three being at par. The sucker development takes place both in the leaf axil as well as the crown region (plant base). After two to three desuckering operations, the maximum sucker development is confined to crown region. It is presumed that the causation of gaps as the plant advances towards maturity contributes more towards sucker development, rather than leaf development probably because of leaves having crossed the limit of taking up new growth/ expansion.

The tobacco yield data reveal that the differences in yield due to two factors viz. Gap (G) and the period of occurrence of Gap (P) were significant (Table 1). The interaction effect G x P was not significant. Thus, the findings reveal that the yield of tobacco increased with the increase in the number of gaps around the plant from G_1 to G_4. The increases in per plant tobacco yield due to G_1, G_2, G_3 and G_4 were 5.7, 11.5, 40.7 and 54.9 per cent respectively over control. The comparison "control v/s gap" showed differential response for tobacco yield indicating the beneficial effect (upward bias) due to gaps. The gap around the plant increases the spacing per plant thereby minimizing the plant competition. At higher spacing with minimum plant competition the plant is expected to put up maximum vegetative growth. However on unit area basis, the gap results in the reduction of plant population which ultimately lead to the reduction in yield. The present findings are in confirmity with those reported by Brewbaker and Deming (1935) and Crews and Jones (1962). Among the periods of gap occurrence, P_3 while not differing from P_2 differed significantly from P_4 and P_1 for yield. The interaction effect, GxP was not significant indicating the independence of both these factors. These findings are also akin to that reported by Crews and Jones (1962).

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