THE EDGE EFFECT IN EXPERIMENTAL *ESPEQUEADO* PLOTS

Joseph J. Bizzarro, Jeffry L. Dudycha, Erik W. Gunderson and Stacey Wooley

Abstract. Edge effects on bean productivity were examined within plots of beans (*Phaseolus vulgaris*) grown using the *espequeado* system of agriculture. Bean plants had higher productivity when in close proximity to bordering mulch. In both treatments studied (0kg/ha and 325kg/ha fertilizer), only plants in rows adjacent to mulch displayed this edge effect. These rows of beans had a higher number of pods and a greater biomass per pod than non-edge rows. The difference in productivity between edge and non-edge rows was more pronounced in unfertilized plots. Also, within both treatments, the productivity of plants in edge rows was greater in rows adjacent to high mulch, when compared to rows adjacent to low mulch borders. Although plants in edge rows probably also experience lower competition from neighboring plants than do plants in the center portions of the plots, we could not distinguish between the reduction in competition and the positive effects of mulch. If the edge effect is even partially attributable to mulch, it would imply that mulch provides advantages to beans even in fertilized plots grown with the *espequeado* system. (JJB)

INTRODUCTION (SAW)

While studying Martha Rosenmeyer's experimental *espequeado* plots at Loma Linda farm, we noticed increased bean growth along the perimeters of many plots (the edge effect). Adjacent plots were separated by one meter of mulch of varying thickness. This mulch may provide additional nutrients and improved physical conditions for bean growth. We hypothesized that plants on the extreme edge of plots would show higher yield, measured by total pods per plant, relative to plants closer to the center of plots. We also predicted that edge plants would exhibit a more pronounced difference in bean yield in unfertilized plots than in plots with fertilizer. We further predicted that this effect would be greater for edge plants surrounded by heavy mulch than in edge plants surrounded by light mulch.

METHODS (EWG)

We collected our data on 2 February 1992 on the experimental bean plots at Loma Linda farm in Coto Brus, Costa Rica. Beans were grown using the *espequeado* system of cultivation in two treatments: 0 kg/ha and 325 kg/ha of 10-30-10 fertilizer (treatments #5 and #6 as classified by M. Rosenmeyer, pers. comm.). The plants were spaced 30cm apart, forming a 4m x 4m grid. 5 plots of each

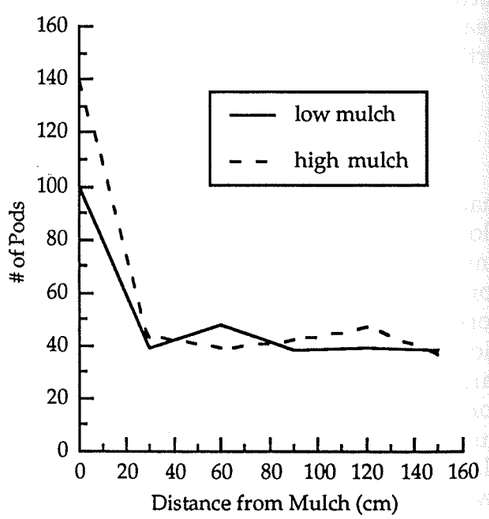

Figure 1. Average number of pods per plant with increasing distance from mulch (Treatment 5).

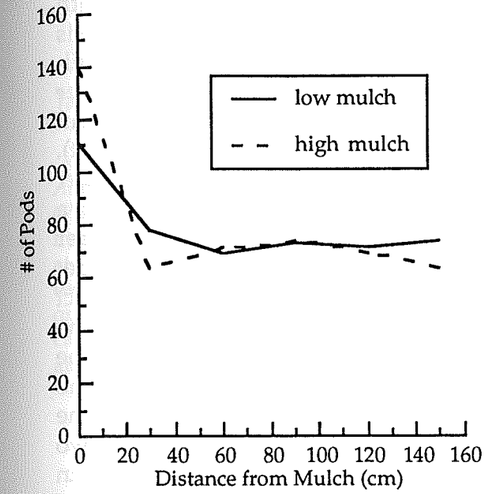

Figure 2. Average number of pods per plant with increasing distance from mulch (Treatment 6).

treatment were observed in 5 different blocks, as established by Rosenmeyer (unpublished data). For each plot, we chose the sides with the lowest and highest amounts of adjacent mulch for observation. On these sides, bean pods were counted on the 5 center plants of each row, for the first 6 rows, counting in from the edge. Only pods which contained seeds were counted on these plants.

RESULTS (JJB, EWG)

For both unfertilized and fertilized treatments, a significantly higher number of pods was produced on plants adjacent to mulch, as compared to the rest of the sample (Figure 1, $t=13.10$, $p<0.001$; Figure 2, $t=9.39$, $p<0.001$). After conversion of numbers of pods to bean biomass, using the results of Shabel, et al. (this volume), this relationship was again significant ($t=3.13$, $p<0.01$; $t=3.90$, $p<0.01$; Table 3).

For non-edge rows, in neither fertilized nor unfertilized treatments, was there any significant correlation between the numbers of pods per plant and distance from edge (unfertilized: $r^2=0.12$, $t=-1.05$, $p>0.2$; fertilized: $r^2=0.06$, $t=.70$, $p>0.4$). The number of pods per plant in edge rows was not significantly different between treatments ($t=0.76$, $p<0.5$). These results suggest that fertilizer had little effect on productivity of edge plants.

However, fertilizer did affect the productivity of center plants ($t=12.0$, $p<0.001$). The number of pods produced in rows adjacent to high mulch

Table 1. Average number of pods per row (low and high mulch: treatment 5).

Row distance (from edge)	Mean # of pods per plant	
	low mulch	high mulch
0 cm.	101.5	140.3
30cm	39.0	43.8
60cm	47.5	38.8
90cm	35.2	42.9
120cm	39.0	45.4
150cm	37.3	37.0

Table 2. Average Number of Pods Per Row (low and high mulch - treatment 6).

Row Distance (from edge)	Mean # of Pods Per Plant	
	low mulch	high mulch
0cm	111.2	142.0
30cm	77.6	64.5
60cm	69.4	73.5
90cm	73.6	74.0
120cm	70.8	68.8
150cm	73.4	63.0

Table 3. Bean biomass per row in treatments 5 and 6.

Treatment 5:		Treatment 6:	
mulch	biomass	mulch	biomass
centr, low	22.1g/row	centr, low	47.2
high	21.9	high	40.5
edge,low	156.3	edge,low	126.7
high	90.2	high	167.2

areas was significantly greater than those adjacent to low mulch in both treatments (Figure 1, $t=2.52$, $p<0.02$; Figure 2, $t=2.14$, $p<0.02$). However, after conversion of pods to bean biomass, a significant difference in biomass was not found between rows adjacent to high and low mulch levels in either treatment (unfertilized: $t=1.00$, $p<0.4$; fertilized: $t=0.16$, $p<0.5$).

Discussion (JLD)

We found that plants on the edges of *espequeado* plots had greater production than those plants nearer the center. This was true whether the plot was fertilized or not (Figures 1 and 2). Regression analysis indicated that all rows except the outermost produce at a similar level, and t-tests showed their production to be significantly less than the outer row. These analyses were done with the numbers of bean pods and may therefore be inaccurate assessments of biomass. Based on the work of Shabel, et al. (this volume), we were able to compare bean biomass of plants in the outer most row with those nearer the center (Table 3). This further supported our hypothesis of greater production in the edge area.

Our second hypothesis, that the difference between edge and center would be greater in unfertilized plots than in fertilized plots was also upheld by our data. We found that both treatments had approximately 28 pods per plant at the edge. However, fertilized plots had significantly greater production (~14 pods per plant) than unfertilized plots (~8 pods per plant). This suggests without mulch, fertilizer increases bean production. Yet if a supply of mulch is nearby, fertilizer has minimal effect on production. This was further supported by the fact that the biomass in the center of the fertilized plot was greater than in the unfertilized plot, while there was no significant difference between the biomass of beans per plant of the two treatments. Production was greater in edges near high mulch than in edges near low mulch. When numbers of pods were converted to biomass, the same comparison was not significant. This indicates that either (i) our range of mulch was too small to detect a bean biomass difference, or (ii) that edge mulch provides nutrients that are directly related to the production of multiple pods, or (iii) that the correlation between number of bean pods and biomass is not as all-encompassing as we thought.

Literature Cited

Shabel, Alan, Sheryl Soucy and John J. Stachowicz. 1992. Bean biomass per pod. This volume.