Plant Density Response of Corn to Shade

Abolhassan Hashemi-Dezfouli and Stephen J. Herbert
Department of Plant and Soil Sciences
University of Massachusetts

Use of high plant densities is an important technique used to increase the yield per unit area. While yield per plant decreases with increased density, total light interception by the canopy is maximized and total yield per acre is increased. The response of grain yield to increase in densities is parabolic, that is it reaches a maximum at a certain density then declines with further increase in plant density. Reduction in grain yield at high densities is partly due to an increase in ear barrenness and/or decrease in number of kernels per ear. A reduction in the number of kernels per ear may result from fewer flower initials being formed prior to flowering, from poor pollination due to desynchronization of tasseling and silking, and from abortion of kernels after fertilization. Although reduction in number of fully developed florets has been reported it seems that the effect of high population densities on extension of the tasseling-to-silking interval and lack of kernel filling are more detrimental.

We used artificial shading to intensify light effects that might exist in high densities. Reduction of incident light, particularly during reproductive growth causes a reduction in grain yield mainly through a decrease in kernel number. Maximum kernel number is established during silking. Therefore, any stress such as water deficit, competition for light or defoliation that delays silking, may cause abortion of kernels at the ear tip and complete barrenness.

The response of field corn to long term shading as density increased was investigated. A single-ear hybrid (Agway 584S) was grown in Agricultural Experiment Station Farm, University of Massachusetts, at 3 densities of 3, 7.5, and 12 plants m^{-2}. Shading was provided by using black polypropylene fabric with 50% light penetration installed 44 days after emergence.

The rate of photosynthesis in ear leaves was reduced significantly by both increased density and shading. The reduction was attributed to reduced photosynthetically active radiation (PAR) in higher densities and shaded plots and to the decreased chlorophyll concentration in leaves of high density plants in both ambient light and shaded plots. Tassel emergence was slightly delayed in high density and shaded plots. However, the time of silking was delayed significantly due to both high density and shading (figure 1). Nine days after 100% tasseling, 10% of plants in high densities and 50% of plants in shaded plots had no silk emerged.

Response of grain yield per unit area in ambient light to increasing density was parabolic. With shade, no increase in yield was obtained with density increase. Shade, reduced number of productive ears per plant together with a reduction in number of kernels per row which resulted in 23% and 66% yield reduction in low and high densities respectively, when compared to ambient light. Weight of individual kernels was reduced 28% with increased density. Shading did not further decrease kernel weight. Number of rows per ear was least sensitive to both density increase and shading.

Figure 1. Pattern of silk emergence in relation to 100% tasseling (86 Days after planting) for light (ambient ___ ; shade ----) and density treatments. Vertical lines represent standard error of mean.

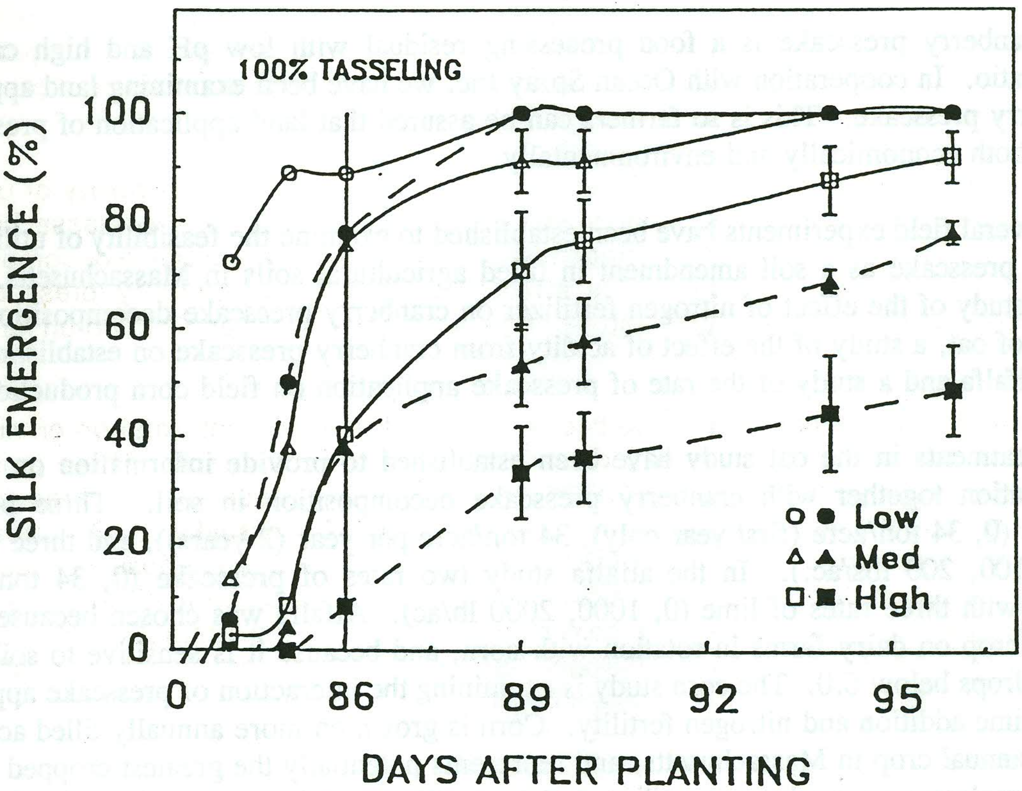

Table 1. Interactive effect of shading and density on yield and yield components. Results are average of 2 years.

Light Treatment	Density	Grain yield†	Kernel yield	Ear $plant^{-1}$	Row# ear^{-1}	Kernel# row^{-1}	Weight $kernel^{-1}$
	Plants m^{-2}	kg ha^{-1}	g $plant^{-1}$				mg
Shaded	3	4812	160.4	1.00	14.1	38.4	298
	7.5	4418	58.9	0.76	13.2	17.3	259
	12	3165	26.4	0.49	12.6	8.7	247
Ambient	3	6223	207.4	1.00	13.9	43.5	344
	7.5	10098	134.6	0.97	13.7	37.6	266
	12	9214	76.8	0.85	13.0	23.9	246

† To convert kg ha^{-1} to lb/ac multiply by 0.892