Response of Soybean to Plant Spacing

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The potential yield of a crop is very specific to the genotype and the environment in which it is grown. For a given genotype, the interaction of density with the arrangements of plants in the field will play a key role in determining the competition for available resources, especially solar radiation, as well as water and nutrients, and thus maximum yield. Duncan (1984) recognized the significance of the interaction of density with field arrangements of plants, and suggested that all forms of interplant competition can be combined into a single term 'crowding'. This includes the effects of both plant population (density) and planting pattern. Based on this concept of crowding, Duncan proposed a model to express the relationship between crowding and yield in a mathematical form. The distance at which crowding becomes zero or negligible is termed Dmax (Figure 1), and is a key parameter in the model for evaluating yield with varying crowding intensities.

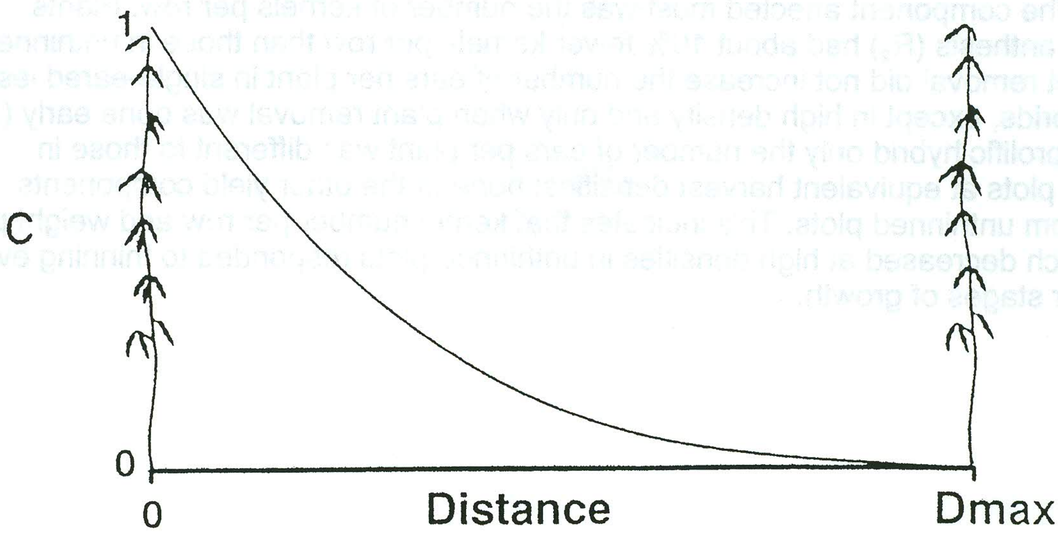

Figure 1. Crowding relationship of a field grown plant to other plants growing in the same field at where crowding (C) between 2 plants growing at zero distance apart equals 1, to a distance apart at Dmax, where C equals zero.

In this research, we determined Dmax for four soybean varieties grown as uniformly spaced ('isolated') plants at 50cm/50cm, 75cm/75cm, 100cm/100cm, and 150cm/150cm spacings in three years by regression, plotting yield per plant against density of uniformly spaced plants. Yield per plant increased as the separation distance between plants increased from 50cm to 100cm, following a quadratic trend each year (Figures 2-5). The yield response to separation was similar between separation distances of 100cm and 150cm between plants.

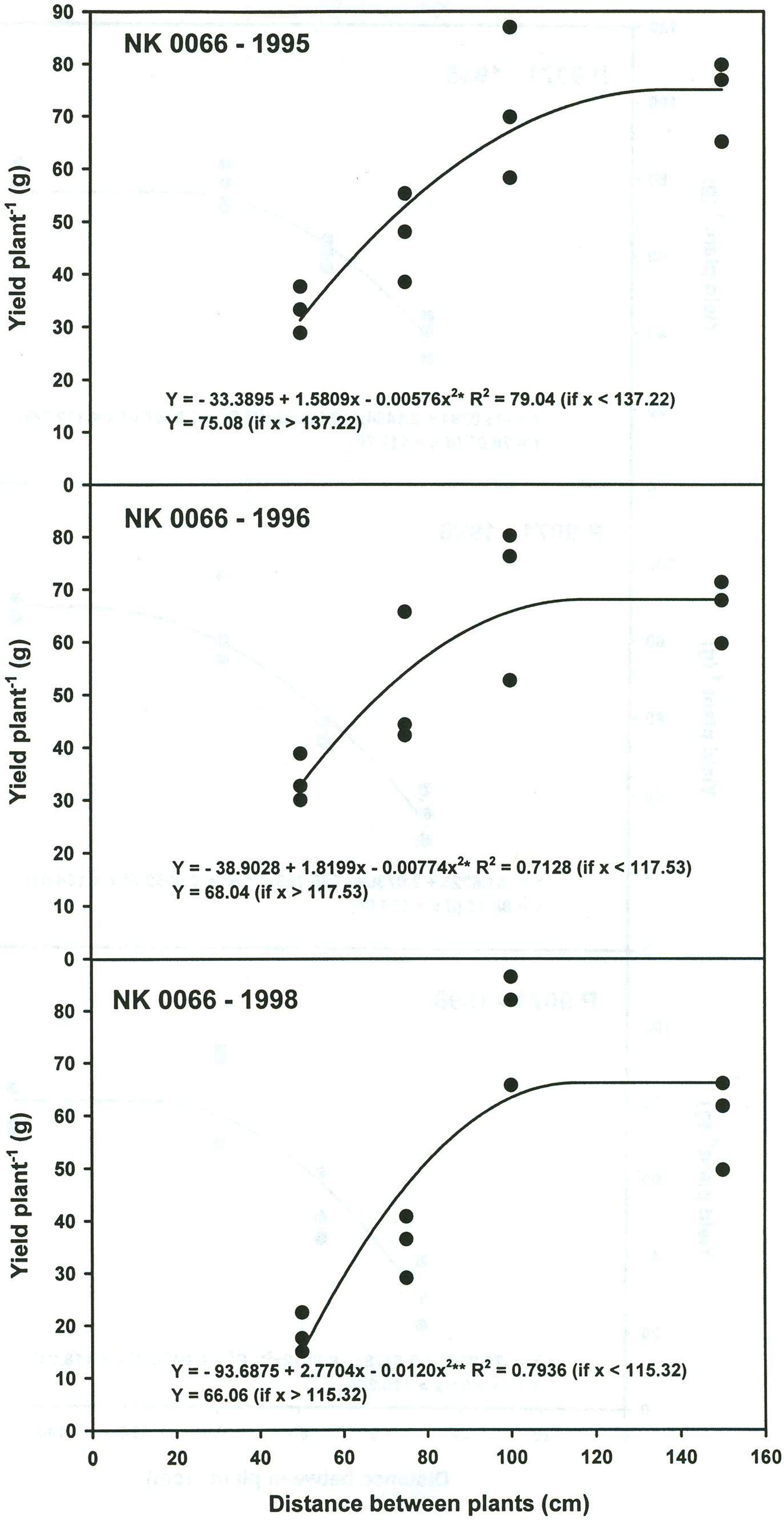

Figure 2. Dmax estimation of NK 0066.

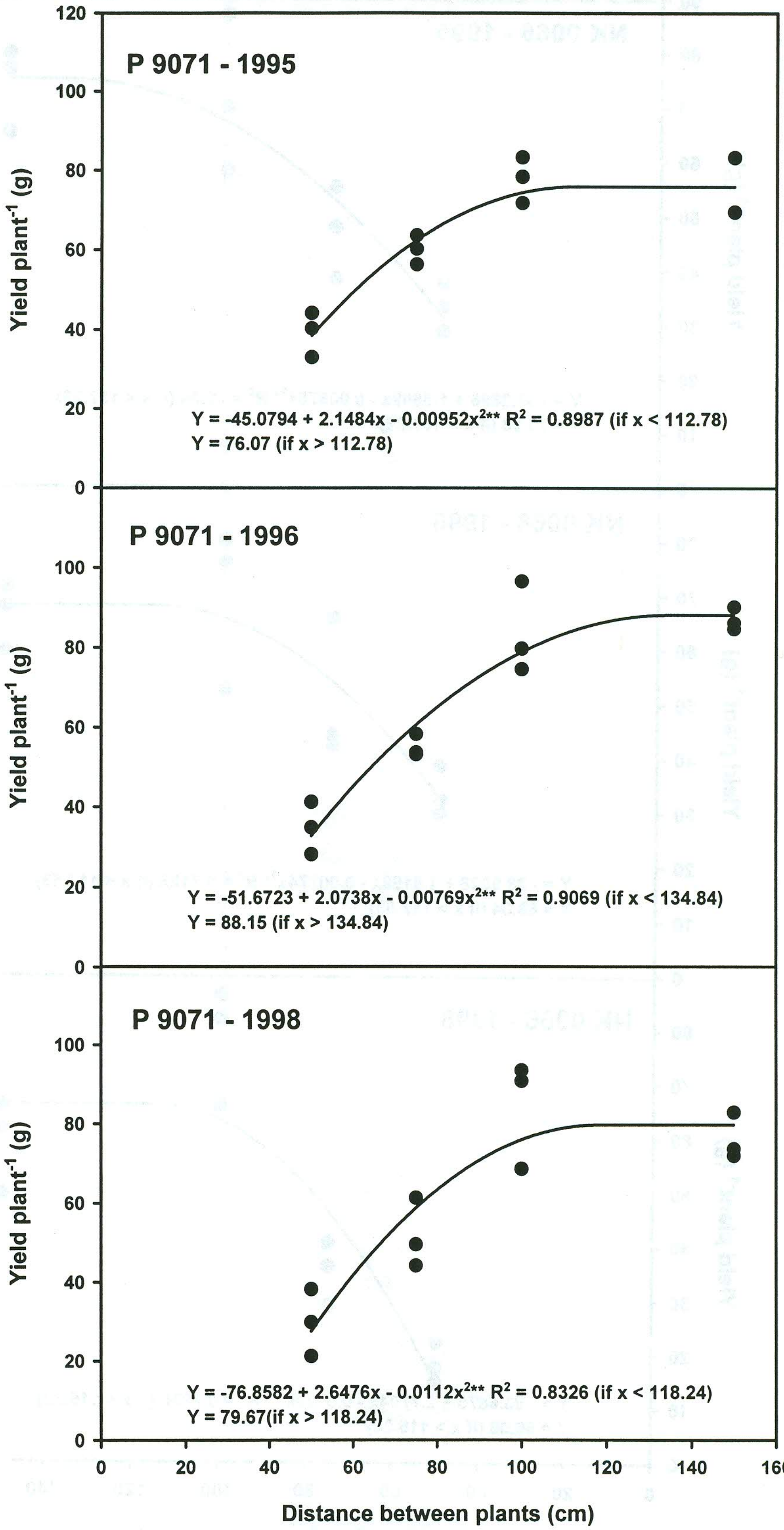

Figure 3. Dmax estimation of P 9071.

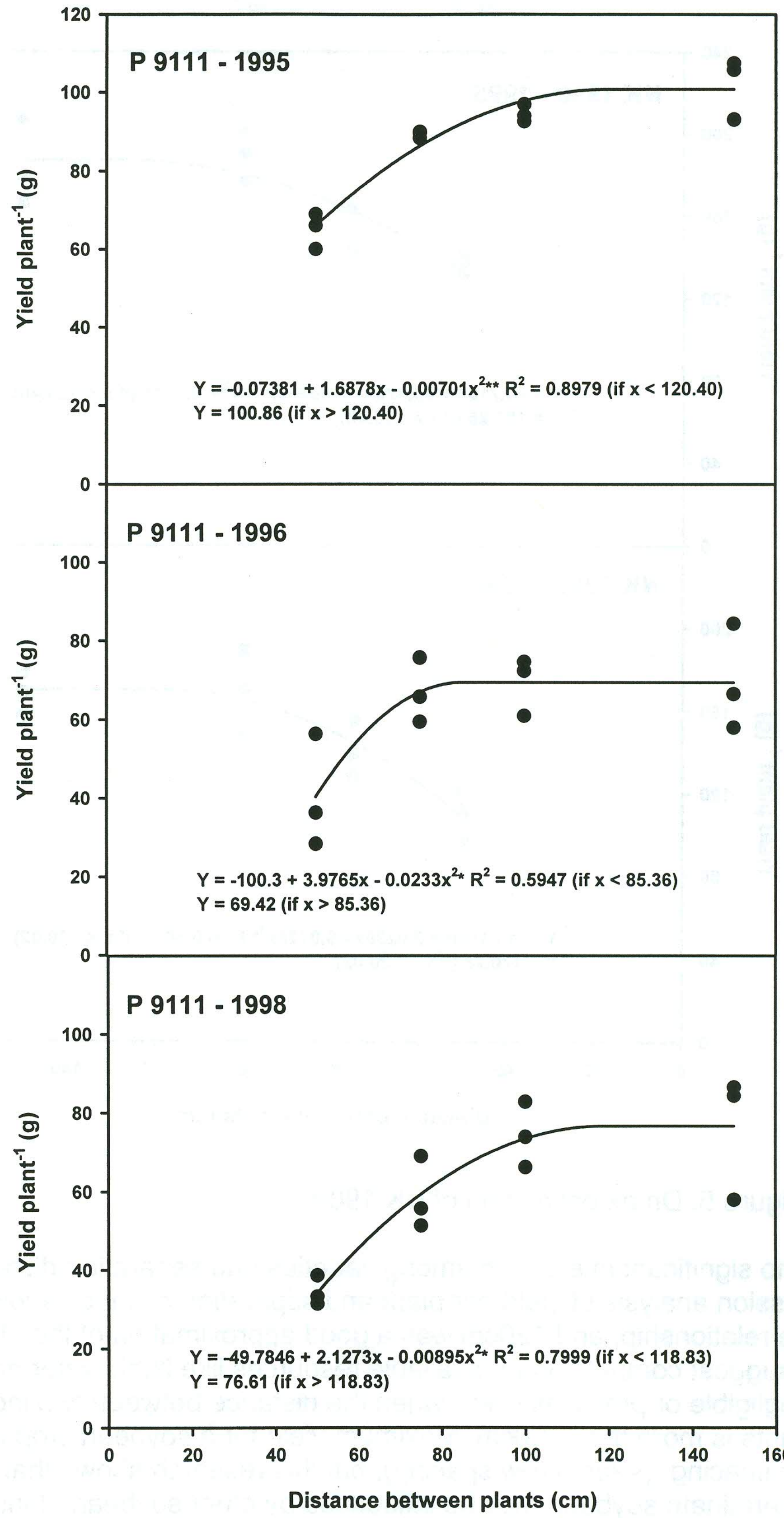

Figure 4. Dmax estimation of P 9111.

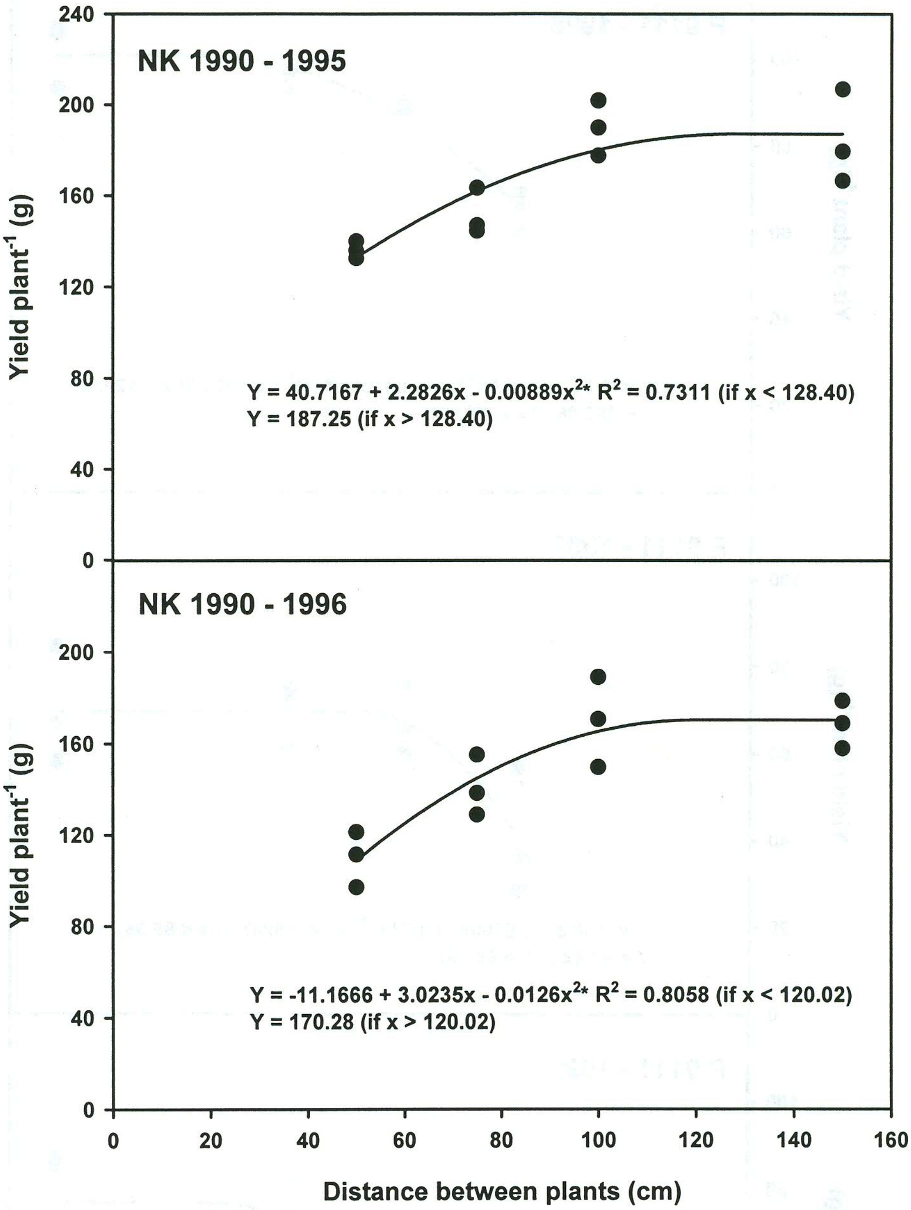

Figure 5. Dmax estimation of NK 1900.

There was no significant interaction among varieties and separation distance in each year. Regression analysis of yield per plant and separation distance showed a quadratic plateau type relationship, and 120cm was a good approximation of the plateau point, or Dmax. We suggest competition for available resources like light, water and nutrients would be negligible or practically zero when the distance between two indeterminate soybean plants is more than 120cm. Maximum yield for a soybean crop will occur at much closer spacing (<25cm row spacing), but this research shows that any plant in a field of indeterminate soybean may be influenced by other soybean plants up to a distance of approximately 120cm. Of course, the closest plants would have the most influence on competitive effect on each other, with much less competition between plants as the separation distance of Dmax is approached.