GROWTH STUDIES WITH PEAS

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ABSTRACT

Two experiments were conducted on vining peas under field conditions and their growth was followed using growth analysis techniques.

In the first experiment, cv Victory Freezer was grown to maturity and the growth parameters total plant dry mass, leaf area and leaf dry mass recorded at weekly intervals for each of four planting densities.

Determination of weekly values of $\overline{R}$, $\overline{E}$ and $\overline{F}$ where $\overline{R}$ is mean relative growth rate, $\overline{E}$ is mean net assimilation rate and $\overline{F}$ is mean leaf area ratio, was unsatisfactory due to harvest variability.

By fitting $\log_e$ values of each parameter over the harvest period to quadratic functions, of the form

$$\hat{Y} = a + bT + cT^2$$

where $\hat{Y}$ is the derived parameter value, a, b, and c are regression constants and T is time, it was possible to calculate instantaneous values for R, E and F. Calculation of R over the whole of growth by this method was not satisfactory.

A third method of deriving R, E and F was then attempted by fitting the logistic function

$$W = A(1-e^{-(\lambda + kT)\theta})^{1/\theta}$$

where W is the required parameter, A is the asymptote, e the base of natural logarithms, λ, k and θ are constants and T time. Values of R obtained by this method appeared to more closely approximate to the growth patterns of peas. However, due to the non-asymptotic growth of leaves the method was not suited to derivation of E and F over the whole of growth. Fitting of growth parameters to the model was also difficult where appreciable variability existed in the parameter to be fitted.

At the lower plant densities, Relative Growth Rate was maintained at a higher level for much of the growth period apparently due to a higher net assimilation rate.

In this experiment maximum yield was shown to occur at the highest plant densities. This was despite lower numbers of pods per plant; numbers of peas per pod and individual pea fresh mass being little affected by density.

The second experiment compared three near isogenic lines of cv Dark Skinned Perfection vining pea, differing only in the expression of leaf, tendril and stipule. Each was grown at the same range of densities as in the first experiment. By the time that this experiment was half grown, the weather conditions were unfavourable for growth, with strong winds, heavy rain and low light levels. These conditions were ideal for the spread of fungal disease and the combination of weather and disease made growth very erratic.

Despite the poor conditions recording of growth parameters continued until no further plots were available for harvest. At that stage only a few plots had commenced fruiting and little yield data was obtained.

The very variable growth parameter records made interpretation of $\overline{R}$, $\overline{E}$ and $\overline{F}$ almost impossible. The ease of fitting the quadratic function made it seem that this was the only method worth attempting for derivation of R, E and F values over the experimental period. Results obtained showed that in contrast to the first experiment the higher density of planting conferred many benefits to the peas. Higher leaf area ratios in the more closely planted plots led to larger values of R in this experiment.

Weather effects on density were mirrored in leaf reduction where the relative growth rate of the least leafy cultivar was much lower than for the more conventional types, due again to lower values of F.

The difficulty in obtaining meaningful mean values of the derived functions in both experiments suggests that different methods of deriving R, E and F are desirable. Using quadratic regression to derive these functions is limited in following whole of growth changes. Fitting of the logistic model is also difficult particularly where harvest variability is high and where the parameters are not basically asymptotic in form. It is suggested that fitting of functions to data over only part of growth may be advisable.

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