YIELD DETERMINANTS IN OILSEED RAPE

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Introduction

Yields of early autumn sown oilseed rape grown under ideal conditions averaged around three tonnes per hectare over a number of years (Shipway, 1981). Such low productivity levels are reflected in the low harvest indices of rapeseed (approximately 21-23%) compared with cereals which average 40-45%. In part this low harvest index may be due to excessive pod and seed losses during flowering (Mendham, Shipway and Scott, 1981; Norton and Shipway. Unpublished observations) but other factors are likely to be involved. Work was initiated to determine the contribution of different plant organs to the dry matter and total green area at different levels within the crop. Information on the location of the green area in the crop profile coupled with radiation measurements should enable tentative conclusions to be drawn with regard to the major photosynthetic and possible assimilatory sites in the crop at the different developmental stages and possibly enable the major factors governing final seed yield and pod and seed losses to be identified.

Experimental and Discussion

Detailed growth analysis using a stratified sampling technique (successive 20cm layers from ground level) revealed that the development of early-autumn sown (21/8/81) oilseed rape (Brassica napus cv Rafal) could be considered to consist of four main growth stages. These were identified as (1) vegetative; (2) flowering and development of the eventual plant framework i.e. attainment of maximum stem area and

weight; (3) pod development, i.e. attainment of maximum pod area and hull weight; (4) deposition of reserve materials in the seeds.

The vegetative phase is important in the establishment of a good ground cover (for the efficient utilisation of incident radiation) and adequate root system. Both features are important in overwintering and early spring growth. Mendham, Shipway and Scott (1981) suggested that growth up to flowering determined the yield potential but the extent to which this is fulfilled is dependent upon subsequent growth stages.

In stage two when flowering and the mature plant structure is developed, major and rapid pod losses occur. The efficiency of utilisation of incident radiation is very low and the shortage of assimilates may be responsible for excessive pod losses and flower abscission. Approximately 25% of the potential pods were lost over a two week period from full flower cover to the completion of anthesis. Although a considerable amount of leaf area persisted during this phase, the efficiency of the leaves in photosynthesis must have been severely reduced through shading. During anthesis the mass of yellow flowers at the top of the crop canopy reflected or absorbed around 65% of the incoming radiation.

In phase three maximum pod area was attained which resulted in the formation of a dense canopy of pod tissues in the upper layers of the crop. The passage of light through these horizons was restricted resulting in the attenuation of radiation in lower crop profile. Excessive pod losses occurred particularly lower down the profile. At maximum pod area only 20% of the incoming radiation was available to the pods lower in the profile. Only 30% of these pods (potential) survived to contribute to the final seed yield compared with more than 80% in the uppermost regions of the crop.

Deposition of reserve materials in the seeds (Stage 4) is dependent upon adequate supplies of assimilates. The assimilate supply is a function of environmental factors and the number of competing seeds. During this phase a rapid increase in crop growth rate (seed dry weight) was evident at a time when leaf tissue was almost absent. There was little mobilisation of materials from other parts of the plants to the developing seed. It was concluded that the pod and possibly pod bearing branches were largely responsible for the dry matter gained during the pod filling stage.

References

Mendham, N.J., Shipway, P.A. and Scott, R.K. (1981). J. agric. Sci. Camb. 96, 389-416.

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