21. L'analyse des conditions de croissance ayant prévalu dans chacun des 56 parcelles, suggère qu'un facteur limitant autre que la lumière est survenu dans les 21 parcelles mettant en défaut la prévision : il s'agit d'une déficience de la nutrition azotée, la première année, conduisant à un avortement excessif de fin floraison et d'un stress hydrique, la seconde année, amenant un défaut de réussite des fleurs en début floraison.

L'examen des nombres de grains par silique moyens renforce les hypothèses précédentes quant aux dates d'occurence des facteurs limitants et autorise une estimation des coefficients liant le nombre de grains et les variables V et Q, du fait de la stabilité des relations linéaires observées entre les deux années et entre les régions.

La prévision du rendement en grains s'avère excellente pour les parcelles d'une petite région la première année. Dans les autres parcelles, l'application du modèle amène une surestimation systématique de 4 à 5 quintaux/hectare. L'étude de ces situations suggère une diminution de l'efficience du rayonnement intercepté par les siliques (1,1 g MS/MJ au lieu de 1,3 g MS/MJ), qui apparaît cohérente avec la valeur du déficit climatique (P-ETP) estimé dans ces parcelles.

A côté du diagnostic cultural immédiat que ces modèles permettent, les possibilités de simulation qu'ils autorisent s'avèrent intéressants pour discuter le choix des itinéraires techniques et des variétés les plus adaptées (sous réserve de les paramétrer pour des variétés différentes de JET NEUF) aux conditions de milieu, permettant, à terme, d'envisager un pilotage de la culture par la définition d'états du peuplement et de dates de réalisation de stades objectifs.

Modelization of Pod Growth and Production in Winter Oilseed Rape : application to the Interpretation of Yields

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This paper is the summary of a dissertation (1) for the degree of "Docteur-Ingénieur" in agricultural sciences submitted on January 29th, 1985, at the Institut National Agronomique Paris-Grignon (France).

The basis for this work lies in the high uncontrolled variability of yields of winter oilseed rape which is chiefly attributable to the varying number of pods per unit area and number of seeds per pod.

In view of this fact, we studied the laws of the functioning of pods which is likely to determine the components of their production.

According to the literature, the major factor of variation of these components is the carbon feeding of pods. This process seems to be linked either with assimilate translocation from plant leaves or with the own photosynthetic activity of pods.

By analogy with the physiology of leaves, we designed a model expecting the succession, in time, of the following two trophic behaviours : pod growth is the result of translocations first (heterotrophy), and then of its own photosynthesis (autotrophy).

(1) Ph. Leterme, 1985. Modélisation de la croissance et de la production des siliques chez le colza d'hiver *(Brassica napus L)* ; application à l'interprétation de résultats de rendements. Thèse de D.D.I. INA-PG. 253 pages.

Field trials carried out at the level of the pod of cv. JET NEUF allowed this model to be verified and improved. These trials consisted in observing the variations in growth and number of seeds per pod in relation to defoliations at various stages of pod development. Results show that :

- The relative elongation rate of the pods aged less than 300 degree-days was decreased by defoliation. These 300 degree-days, which represent the elongation phase, can thus be considered as a period of heterotrophy.
- On the other hand, defoliation had no effect on the further increase in dry matter which occurs during 600-700 degree days. This lack of effect is characteristic of autotrophic behaviour.

Defoliation had a detrimental effect on both increase in pod length (unless defoliation occurred late) and number of seeds. Examining the conditions of variation in seed number led to the following assumption :

- For a short period of time following fertilization (3 days) the rate of supply of assimilates determines a potential number of seeds. For a given leaf area (source of photosynthates during heterotrophy) and a given number of flowers (photosynthate-consuming sinks), this rate results from the radiation/temperature ratio.
- Over the rest of the heterotrophy period, the total amount of photosynthetates supplied to the pod determines the degree of realization of the potential. By the end of heterotrophy, the number of seeds is definitely fixed.

The growth rate of pods observed during the period of autotrophy indicated that the amount of dry matter produced per unit time corresponds to the minimum level of :

- the climatically possible growth rate which results from the amount of radiation intercepted by the pod. The efficiency of this radiation was estimated in average at 1.3 g DM/MJ during the period of autotrophy.
- the potential growth rate of the pod, related to its length and number of seeds. For each pod compartment, there is a maximum growth rate of the order of 1.5 mg/100 degree-days for one seed and 3.4 mg/100 degree-days for one centimeter of husk.

The distribution of dry matter produced by the pod between husk and seed in the course of time was examined. Within the first 300 degree-days of autotrophy, the walls appear to have priority : a decrease in overall pod growth affects the growth of seeds first. During the following 300 degree-days, the order of effects is inverted : seeds seem to have priority.

The growth rates of each part of the pod combined with the duration of phases can account for final weights.

Since the purpose of this work is to understand the results obtained in agricultural fields, the second part of the thesis deals with the possibility of deriving from the model of pod physiological activity, other models of plant population activity. This implies that the problems related to the various position and to the different ages of pods in the plant canopy are solved.

The first source of heterogeneity has been integrated by using models of light interception derived from the law of BEER, allowing the average incoming radiation for one pod to be estimated while taking into account the surface area of the pods which shade it.

It was more difficult to integrate the differences in pod age, due to the lack of a model of flowering chronology. We searched for periods of the crop growing season which would be representative first of the prevailing pod heterotrophy, then of autotrophy, on the basis of variable flowering kinetics encountered in the plots. The flowering period itself appears to be best suitable to characterize the prevailing heterotrophy, while the 600 degree-days starting 300 degree-days after mid-flowering are most adequate to characterize the autotrophy.

Prediction of seed yield proves to be excellent for the fields of a small region in the first year. In the other fields, the applied model led to systematic overestimation by 0.4-0.5 ton/hectare. The above results suggest the decreased efficiency of radiation intercepted by pods (1.1 g DM/MJ instead of 1.3 g DM/MJ) which seems consistent with the climatic deficiency (rainfall minus potential evapotranspiration) estimated in the fields.

In addition to immediate cropping diagnosis, these models allow simulations which prove of interest when there is a need to discuss the technical procedures and the varieties best adapted to environmental conditions (provided that they are parametrized for varieties other than JET NEUF).