FLOWERING ECOPHYSIOLOGY OF HEMP (CANNABIS SATIVA L.) AS A FIRST STEP TOWARDS SPECIES BREEDING

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Hemp (Cannabis sativa L.) is a naturally dioecious species with flowering responding to daylength variations. The acquisition of monoecious varieties remains an eternal renewal because of their instability: firstly, the late apparition of sexual dimorphism prevents the total eradication of dioecious male plants during the selection process, and, secondly, the monoecious state presents a continuous distribution between the male and female extreme phenotypes. Hemp is also known to be a quantitative short-day plant. Maximum stem yield seems to occur shortly after flowering. Therefore, photoperiodic conditions have a key influence on the determination of yield potential of the crop. In the context of renewed interest for alternative fibre crops, understanding the flowering system of hemp could offer valuable information to support species breeding and cultivation. The present study aims to describe the floral development, growth and biomass production of hemp as well as the expression of the sexual phenotype in response to photoperiod and temperature conditions.

Trials were settled in the field and in controlled conditions. Five monoecious varieties of different precocities were cultivated in 2007 and 2008 during five culture periods in two sites with different edapho-climatic conditions in Belgium. The first culture period ran from Mid-April to end of September and the last one from end of June to Mid-November. The same varieties were cultivated from January to June 2008 in growth chambers under five controlled photoperiods from 10 to 18 hours.

In the field, mean thermal times to reach a particular development stage were congruent between both years. Growth rhythm and biomass production appeared to be correlated with floral development rhythm. Lower floral development and growth rates, and the consequent higher biomass production, were observed for the first culture periods and could be explained by the longer daylength conditions experimented by these treatments. Three phases of growth were determined: an accelerating phase before 400-500°Cd, a linear phase between 400-500 and 1200-1500°Cd and a saturating phase after 1200-1500°Cd (base 1°C). The effect of temperature on growth, pointed out in 2007 during the linear phase of growth, was less obvious in 2008. Temperature and length of cultivation cycle seemed to influence positively the production of biomass. The highest yields were observed when sowing and harvesting were achieved in Mid-April and end of September, respectively.

In controlled conditions, sex ratio and evolution of flowering stages were observed at each node separately. All varieties presented a typical floral response of short-day plants, with flowering occurring faster at daylengths shorter than 14 hours. The analysis of the distribution of the sexual
phenotypes allowed the identification of times intervals and nodes ranges which could be used for future description of the sexual phenotype of hemp plants.

Finally, the observations and results of this first ecophysiological approach should lead us to propose a flowering model for hemp and provide us precious information which may be introduced in a second step, the approach of sex determinism by the QTL method.