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3D distribution of seed yield in alfalfa seed canopy

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SUMMARY – The exhaustive description of the canopy structure is helpful in analysing the seed yield components and in understanding the yield elaboration. Spatial distribution of seed yield was investigated in canopies of cv. Europe. On 1 m^2 plots, all the stems were collected. They were gathered in classes according to the number of fertile inflorescences carried on their mainstem. The number of stems per class was variable across environments but whatever the canopy structure few stems had more than 11 mainstem inflorescences. The seed weight per inflorescence (SWI) was measured for each node position and stem class. The SWI for a given node increased with the number of fertile inflorescences. Along a stem, in a given class, it tends to decline at the upper position. It was shown that the inflorescences of stems carrying few inflorescences weighed similarly to the upper inflorescences of long stems. Thus, a unique relationship was developed between the SWI and the position of the inflorescence counted from the top. The dominant stems give an adequate image of this relationship. The number of inflorescences carried by the branches of a given stem class is fully related to the number of mainstem inflorescences. The patterns were similar for different canopies with contrasting seed yield. Thus, there are strong physical and physiological rules regulating the seed yield elaboration within a canopy.

Key words: *Medicago sativa*, inflorescence, architecture, stem.

***RESUME –** "Distribution tridimensionnelle du rendement grainier dans un couvert de luzerne". La description exhaustive de la structure du couvert est utile pour analyser les composantes du rendement grainier et comprendre l'élaboration du rendement. La distribution spatiale du rendement grainier a été décrite dans des couverts de la variété Europe. Sur des parcelles de 1 m^2, toutes les tiges ont été récoltées. Elles ont été rassemblées en classes selon le nombre d'inflorescences fertiles qu'elles portaient sur leur tige principale. Le nombre de tiges par classe était variable selon les milieux, mais quelleque soit la structure du couvert, peu de tiges portaient plus de 11 inflorescences sur la tige principale. Le poids de graines par inflorescence (SWI) a été mesuré pour chaque nœud et chaque classe de tige. Le SWI pour un nœud donné augmentait avec le nombre d'inflorescences fertiles. Le long de la tige, dans une classe donnée, il tendait à décroître aux nœuds supérieurs. Il a été montré que les inflorescences de tiges portant peu d'inflorescences avaient le même poids que les inflorescences du haut des grandes tiges. Ainsi, une relation unique a été développée entre le SWI et la position de l'inflorescence comptée depuis le haut de la tige. Les tiges dominantes donnent une bonne image de cette relation. Le nombre d'inflorescences portées par les ramifications d'une classe de tiges donnée est bien reliée au nombre d'inflorescences de la tige principale. Le schéma était similaire pour des couverts différents ayant des rendements grainiers contrastés. Ainsi, il y a des règles physiques et physiologiques fortes qui régulent l'élaboration du rendement grainier dans le couvert.*

Mots-clés : Medicago sativa*, inflorescence, architecture, tige.*

Introduction

Alfalfa seed crops show a complex structure. Genetic variation among plants and differences among stems within plants determine the stem population. Variation exists among the inflorescences of a given stem. Thus, spatial structure is very complex.

Exhaustive description of the spatial canopy structure is helpful in analysing seed yield components and in understanding the yield elaboration.

The present study aimed at describing the structure of different canopies of cultivar Europe, grown in different environmental conditions. The present paper will show patterns common to all the studied conditions. These patterns will be illustrated with data from one environmental condition.

Materials and methods

Crops of cultivar Europe were grown in 1998 in two sites, Lusignan and Marans run by INRA or by FNAMS (Fédération Nationale des Agriculteurs Multiplicateurs de Semences), respectively. In Lusignan, a one-year old crop was analysed. In Marans, a one-year old crop and a two-years old crop were studied. Pollination was ensured by native pollinators that were abundant in all trial sites and assumed not to be a limiting factor.

At maturity, all the stems were cut at 6 cm above ground on 0.9 m^2 sub-plots. Sub-plots had 2 rows, 0.45 m apart, and 1 m long. Sub-plots were included in larger plots to avoid border effects. For each environmental condition, two replicates were sampled.

Stems were classified according to the number of inflorescences on the main stem (1-9). Class 10 gathered the stems with 10 or more fertile inflorescences. The number of stems in each class was counted. In each class, the inflorescences from each node position were collected and threshed to calculate the seed weight per inflorescence. The branches and their number of inflorescences were counted. The inflorescences were threshed. The mean number of branches per stem, mean number of branch inflorescences per stem and the mean seed weight per inflorescence were calculated.

The present poster illustrates the major results with the data from the one-year old crop in Marans.

Results

Number of stems per class

Figure 1 shows the number of stems in the different classes defined by the number of fertile inflorescences on the main stem.

In the case shown on Fig. 1, the number of stems in the different classes was constant from class 1 to 10 and it declined for the higher classes. This is relevant with the mean number of main stem inflorescences reported on the dominant stems in alfalfa seed crops. The number of sterile stems per m^2 reached 95. The main stem height increased linearly with the number of fertile inflorescences.

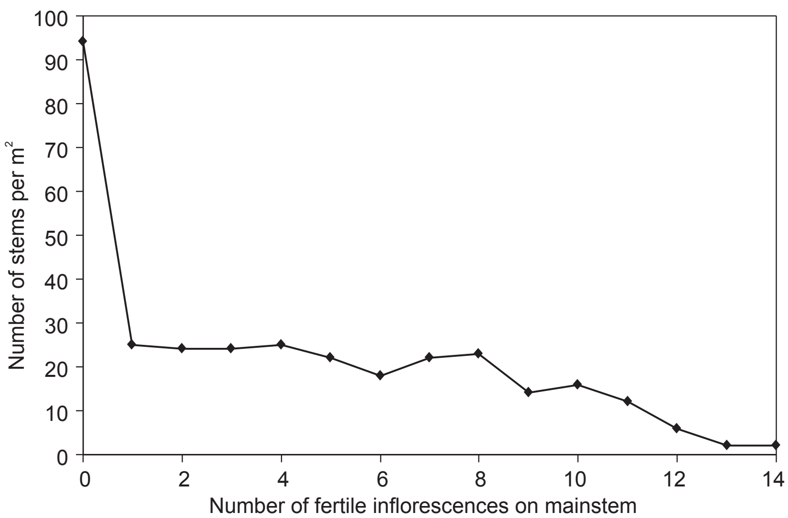

Fig. 1. Number of stems per class.

In the other situations under study, few stems carried more than 10 inflorescences. However, the distribution of stems in the different classes was different with a maximum for the classes 7 to 9.

Seed weight per inflorescence as a function of its position

The seed weight per inflorescence as a function of its position in each stem class is shown on Fig. 2. The curve shape for the different class is very similar, with a maximum usually met at position 2 or 3. The value of this maximum increased with the total number of inflorescences carried by the stems.

The profile becomes more even when the inflorescence position is counted from the top of the stems (Fig. 3). A simple relationship may be defined.

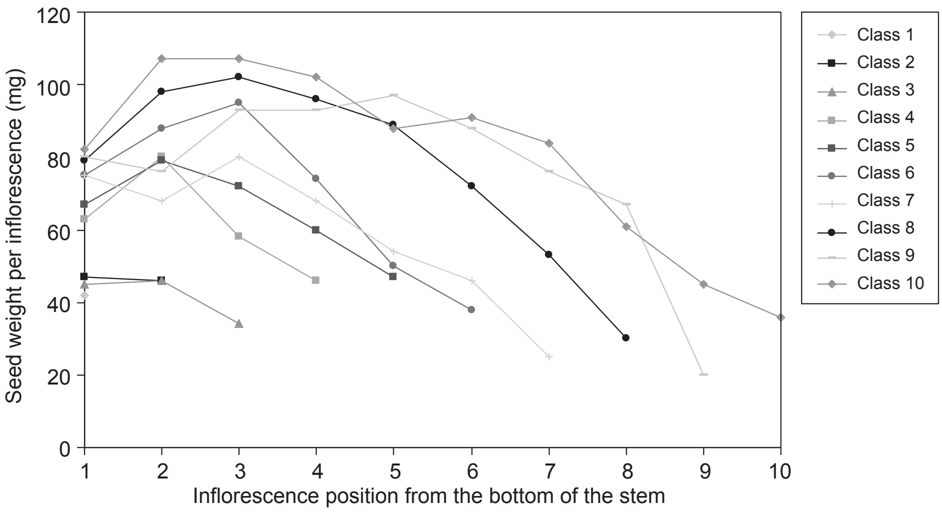

Fig. 2. Seed weight per inflorescence as a function of the inflorescence position and the stem class.

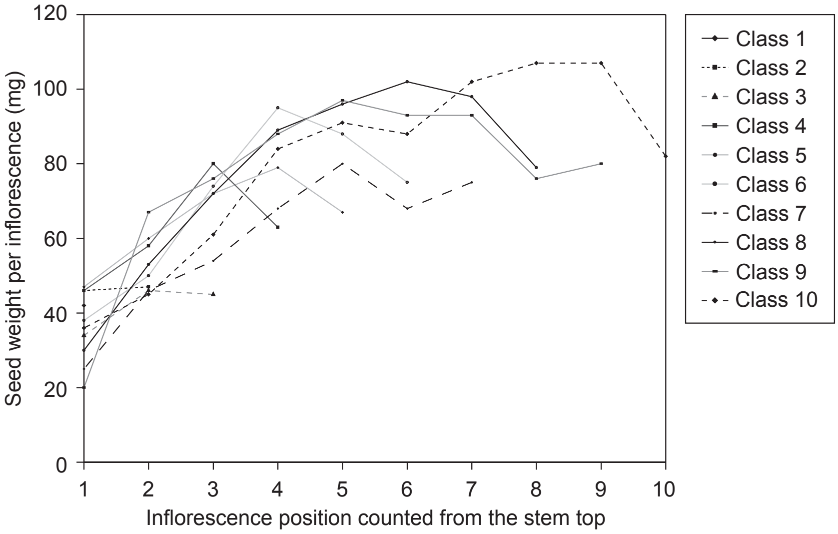

Fig. 3. Seed weight per inflorescence for the different stem classes as a function of the position counted from the top.

Structure of the branches

The frequency of occurrence of branches and the number of branches per stem increased with the number of inflorescences on the mainstem. As the mean number of inflorescences per branch appeared to be stable, the number of inflorescences from branches increased linearly with the number of fertile inflorescences on the mainstems (Fig. 4).

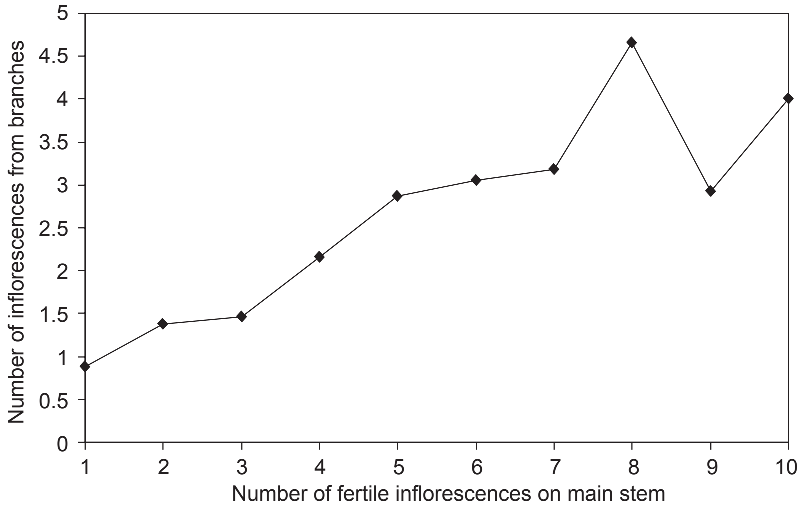

Fig. 4. Relationship between the number of inflorescences on main stem and the number of inflorescences from branches

Discussion

Simple relationships were found in alfalfa seed canopies. The seed weight per inflorescence is a simple function of the stem class and the inflorescence position. This suggests a strong physiological regulation within the canopy. Similarly, the branch structure appeared to be highly related to the structure of the main stem. Thus, it should be possible to predict these values from easily measurable traits.

On the opposite, the number of stems per class seemed to be more variable and less easy to describe and understand. More data will be needed to investigate this feature.

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