# EFFECTS OF HEAT STRESS AND POPULATION ON REPRODUCTIVE STRUCTURES OF LIMA BEANS

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Lima beans (Phaseolus lunatus) are the major processing vegetable crop in Delaware. Yields of shelled green beans have averaged 1,700 lbs./acre for over 30 years. Producers have experienced higher yields in later plantings, those that reproduce and mature during cooler conditions. Other producing regions, most notably California, routinely produce higher yields. Studies were initated to study the effect of field conditions on reproductive structures in Delaware and California.

## Floral Ontogeny

'M-15' and 'F1072' lima beans developed multiple flower clusters at each node during the life cycle of the plant. The plants were able to develop flower clusters (reflower) up to 3 times. Although 'M-15' and 'F-1072' did reflower at the Delaware location, reflowering had a greater influence on yield in California than in Delaware.

Plot location affected the number of buds developing into flowers for 'M-15'. Bud development into flowers was greater in Califonria than in Delaware. 'F1072' grown in CA had more buds developing into flowers than the DE Early planting. No differences in bud development into flowers occurred between the DE Late and CA, or the DE Early and De Late plantings.

Above-canopy and within-canopy raceme positions were studied. Plot location had no effect on the number of structures formed per raceme for the original flower set of 'M-15'. The CA planting had more flowers, pins, and pods than the DE Early and DE Late plantings in reflower 1, and more flowers and pins in reflower 2. Raceme yield indicated that racemes were unaffected by plot location for the 1991 plantings of 'M-15' and F-1072'. Yield per raceme was also unaffected by raceme position. Air temperature and relative humidity values recorded at above-canopy and within-canopy positions were similar.

Previous research indicates the first flowers produced are the most productive in lima beans. Results from 1991 reveal that the earliest flowers produced for 'M-15' and 'F-1072', grown in Delaware, were the most productive. 96% and 100% of the pods at harvest for 'M-15' were produced from the original flowr set for DE Early and DE Late respectively. 100% of the pods at harvest for 'F1072' originated in the original flower set. However, pods in the CA planting originated in the following: 25%-original flower set, 58% in reflower 1, and 17% in reflower 2.

Studies conducted in 1992 demonstrated that plant population densities did affect floral ontogeny for 'M-15' grown in Delaware in 1992. 'M-15' at the lower plant populaton density averaged significantly more buds, flowers, and pins per raceme in the original flower set, than the higher plant populaton density

Plant population densities did not affect yield per raceme of 'M-15' and 'F1072', nor was air temperature and relative humidity within the canopy affected by plant spacing.

Yield

'M-15' and 'F1072' final yields in 1991 re-affirmed the large difference in yield between Delaware and California. California had a greater number of plants, plant fresh weight, number of green pods and total yield than the Delaware planting. Plant populations did differ between locations in 1991; 14.3 seeds/m of row in Delaware and 25 seeds/m of row in California. Differences in plant population densities were compared in 1992.

Yields differed by plot location and cultvar. Although 'M-15' yields were higher than 'F1072' in Delaware, 'F1072' yielded the same as 'M-15' in California.

High relative humidity, high soil moisture and cool night temperatures provide the idea growing environment for lima bean production. However, high relative humidity coupled with high night temperatures has an adverse affect on yields (Fisher &Weaver). Minimum air temperatures in Delaware and California were compared in 1991. Minimum air temperatures were higher in the DE Early planting than the CA planting. However, minimum air temperatures were lower in the DE Late planting than the CA planting. Although minimum air temperatures in the De Late planting were cooler than the minimum air temperature in California. California had higher yields than the DE Late planting. A capacity set theory for lima beans was purposed by Cordner in 1928. He states that lima beans continue to set pods until a "capacity set" is obtained, after which the plant abscises unwanted structures. Bud, flower, and pod formation and abscission data from 1991 indicated support for Cordner's capacity set theory. Each large peak in pod formation was followed by a large peak in bud and flower abscissions for 'M-15 and 'F1072'.

Increasing plant populations densities did not increase yields of 'M-15' and 'F1072'. Yields in California were higher than in Delaware, even through the same plant spacing was used As in 1991, the number of green pods and total yield for California were greater than in Delawae

References

1. Cordner, H.B. 1928. External and Internal Factors Affecting Blossom Drop and Set of Pods in Lima Beans. ASHS Proceedings 30:571.

2. Fisher, V.J. and Weaver, C.K. 1974. Flowering, Pod Set, and Pod Retention of Lima Bean in Response to Night Temperature, Humidity, and Soil Moisture. J. Amer. Soc. Hort. Sci. 99.48.