SEED GROWTH PATTERNS AND SEED SIZE RELATIONSHIPS IN SHORT SEASON SOYBEANS

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Several experiments are presented in this paper which reports the influence of row width, density and nodal position on seed size (weight per seed) for short season indeterminate soybeans. The experiments involved genotypes in maturity groups 00, 0 and I, and all experiments were conducted at the Massachusetts Agricultural Experiment Station farm in South Deerfield, from 1979 to 1983. Normal cultural management practices were followed; the beans were inoculated with a granular soil applied, peat based inoculum and weed control was achieved through the use of alachlor and linuron (Lasso and Lorox).

In 1979 and 1980 two cultural factors, row spacing and plant density, were evaluated for Evans soybean. Neither of these factors resulted in a change in seed size within a given season but large differences occurred between seasons. In 1979 when seeds averaged 126 mg/seed compared to 165 mg/seed in 1980, there was either a shorter effective filling period (EFP) or a slower seed growth rate compared to 1980. It has been suggested that soybean plants growing in the field, at flowering or soon thereafter have responded to the environment so they maintain a suitable relationship between their source-sink ratio and the environment. That is, plants in low density plots have branched more and have set more pods per plant than plants in high densities, thereby exploiting within limits the environment to an extent similar to the high density crop. This results in seeds being of a similar size in low and high densities (and narrow and wide rows).

In 1982 an extension of the above study was to examine seed size in pods with differing seed numbers. Figure 1 shows that seed size for Altona and Evans soybeans is not only constant for all combinations of row widths and densities but is also similar for all nodal positions. Deviation from the norm at lowermost and uppermost nodes is probably due to the smaller sample size at these nodes, since few pods occurred at these node positions. In Figure 2 seed size is divided on the basis of how many seeds there were in each pod. Here seed size was found to be the same for a given cultural practice regardless of how many seeds there were in a pod.

Also in 1982 in a separate experiment 23 soybean genotypes, including many plant introductions (unnamed varieties) were evaluated for seed size relationships. These genotypes ranged in size from about 100 to 220 mg/seed (Figure 3). Upon examination of these genotypes it was found all had seed sizes similar for that genotype across all node positions as had been found for Altona and Evans with varying cultural management in other studies. A representative number of these is shown in Figure 4, together with eight of the same genotypes grown in two row widths in 1983.

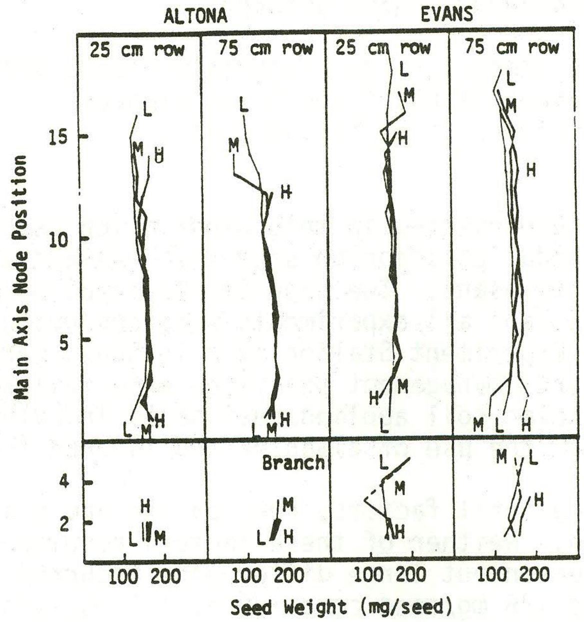

Figure 1. Mean weight per seed on a nodal basis for Altona and Evans soybeans. L, M, H indicate low, medium and high densities (respectively, 25, 50 and 75 plants/m^2).

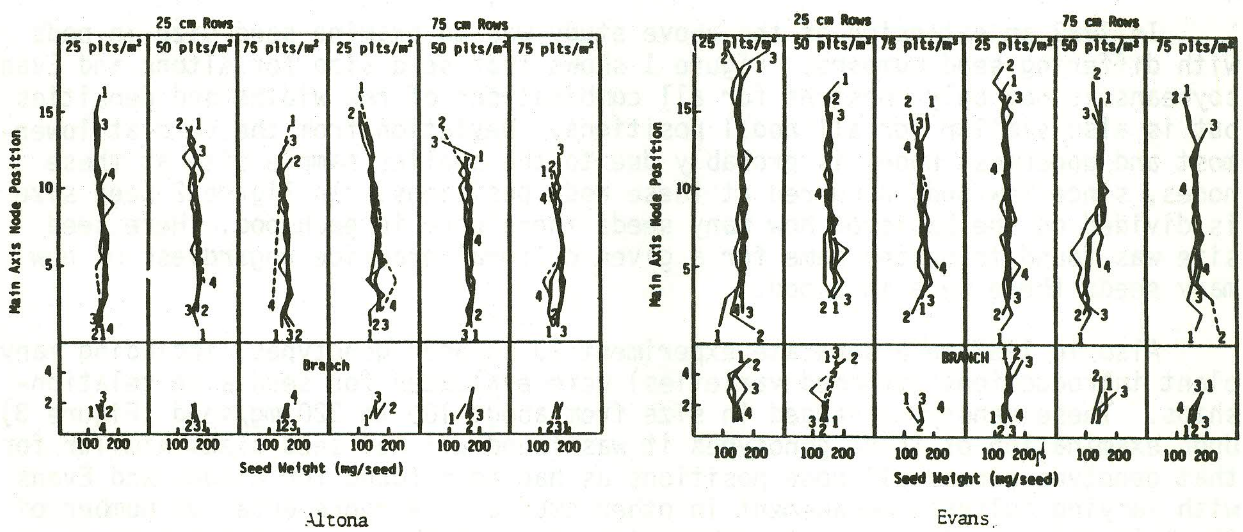

Figure 2. Mean weight per seed based on number of seeds per pod on a nodal basis for Altona and Evans soybeans. 1, 2, 3 and 4 indicate seeds from 1, 2, 3 and 4-seeded pods respectively.

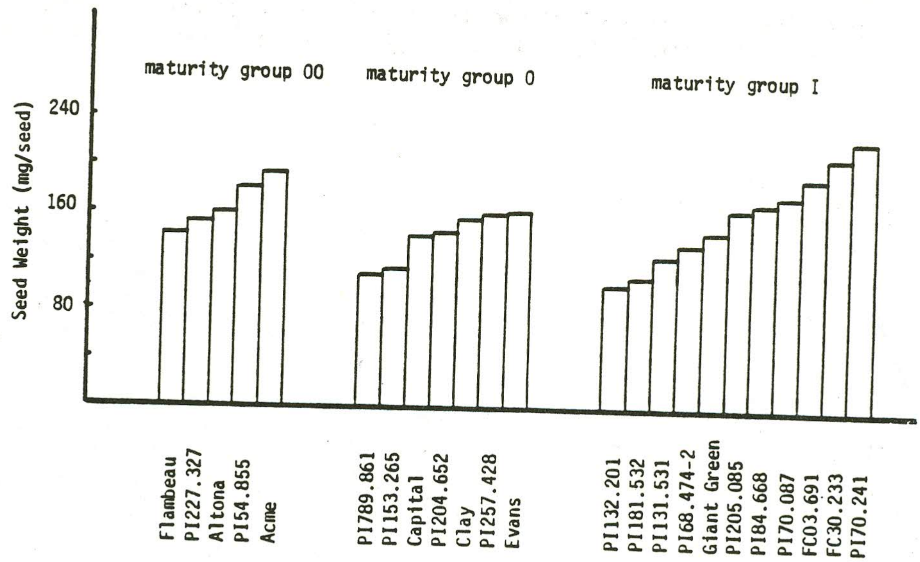

Figure 3. Mean weight per seed for different maturity groups of 23 soybean genotypes.

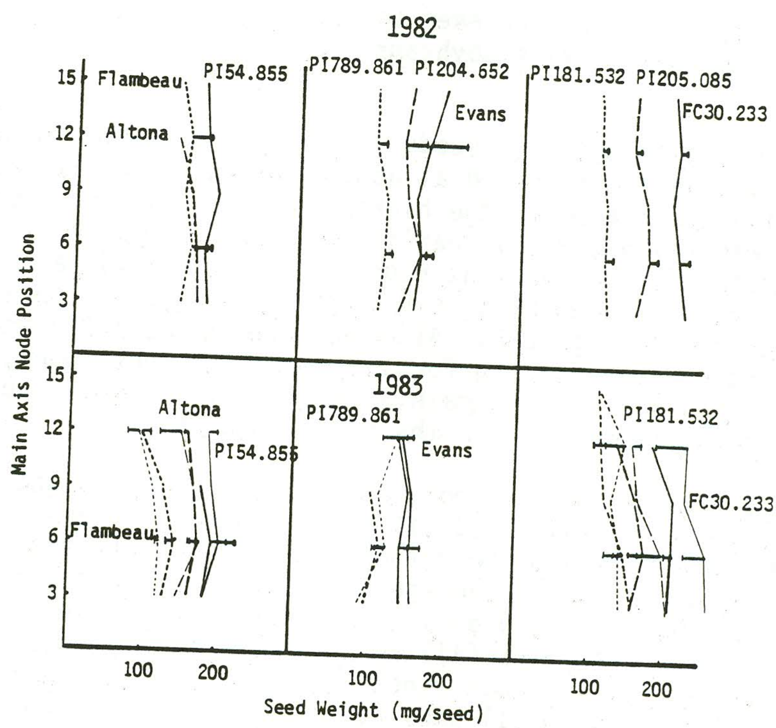

Figure 4. Mean weight per seed for main axis nodes of different maturity group soybeans. The 95% confidence intervals are shown by horizontal bars (thin lines represent narrow rows and thick lines represent wide rows in 1983).

Figure 5 shows seed growth (main axis) patterns for Altona and Evans. Ten plants of each variety were sampled twice weekly and weight of developing seeds recorded. For Evans the linear seed growth phase began roughly 20 days earlier for seeds at node 3 compared to seeds at node 15. In both cultivars growth of

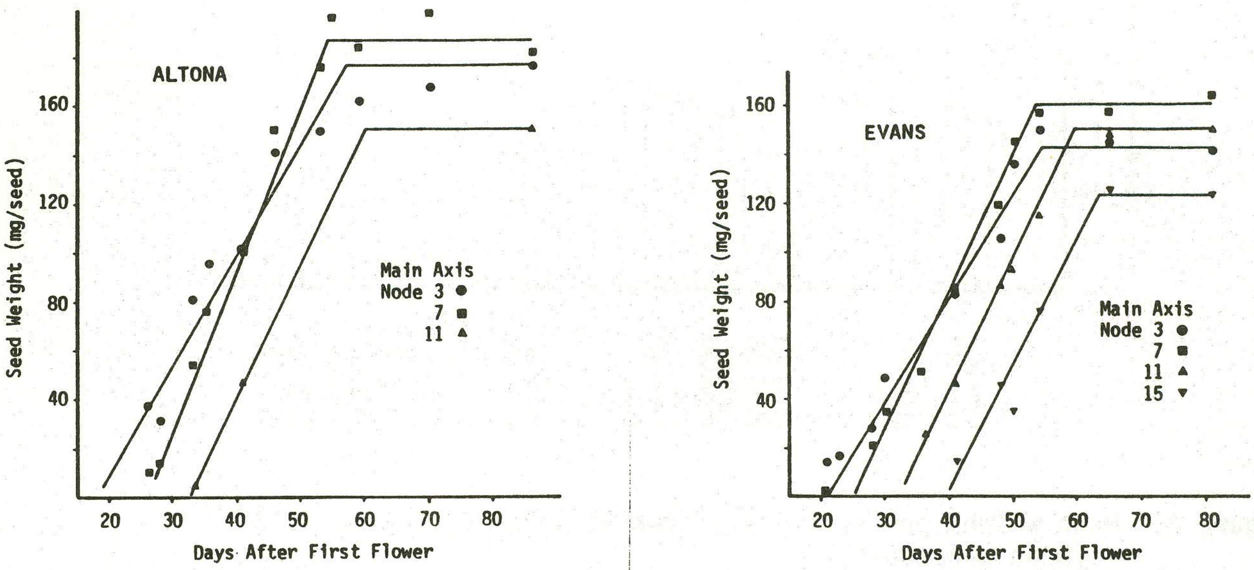

Figure 5. Mean weight increase per seed of main axis nodes 3, 7, 11 and 15 for Altona and Evans soybeans.

seeds at node 7 was higher than for seeds at node 3. Thus the effective filling period for seeds at node 7 terminated at about the same time as seeds at node 3 and before filling terminated at the higher nodes 11 and 15. For Evans maximum seed size was reached 9 days earlier at node 7 compared to node 15. Effective filling periods for Evans at nodes 3, 7, 11 and 15 were 34, 29, 27 and 23 days respectively. Differences in developmental stage of these nodes are pictorially illustrated in Figure 6. Although there were differences in the beginning and ending of seed filling for seeds at different nodes, final seed size was found to be similar at all main axis nodes irrespective of the number of seeds per pod as had been found in the other studies.

This study has shown that the seeds at lower nodes began and ended their linear growth phase earlier than seeds at upper nodes. In some years it has been observed that seed size was lower than its genetic potential. Thus is might be expected in a year where average seed size for the plant is lower than in another year that this would have resulted from smaller seeds at upper nodes owing to a shorter effective filling period of upper nodes. Our results have shown that this is not the case since in any given year seed size has remained relatively constant in all pods at all nodes. This suggests there must be some regulatory mechanism within the seed or maybe within the plant that causes all seeds to attain a similar size even though they fill at different times.

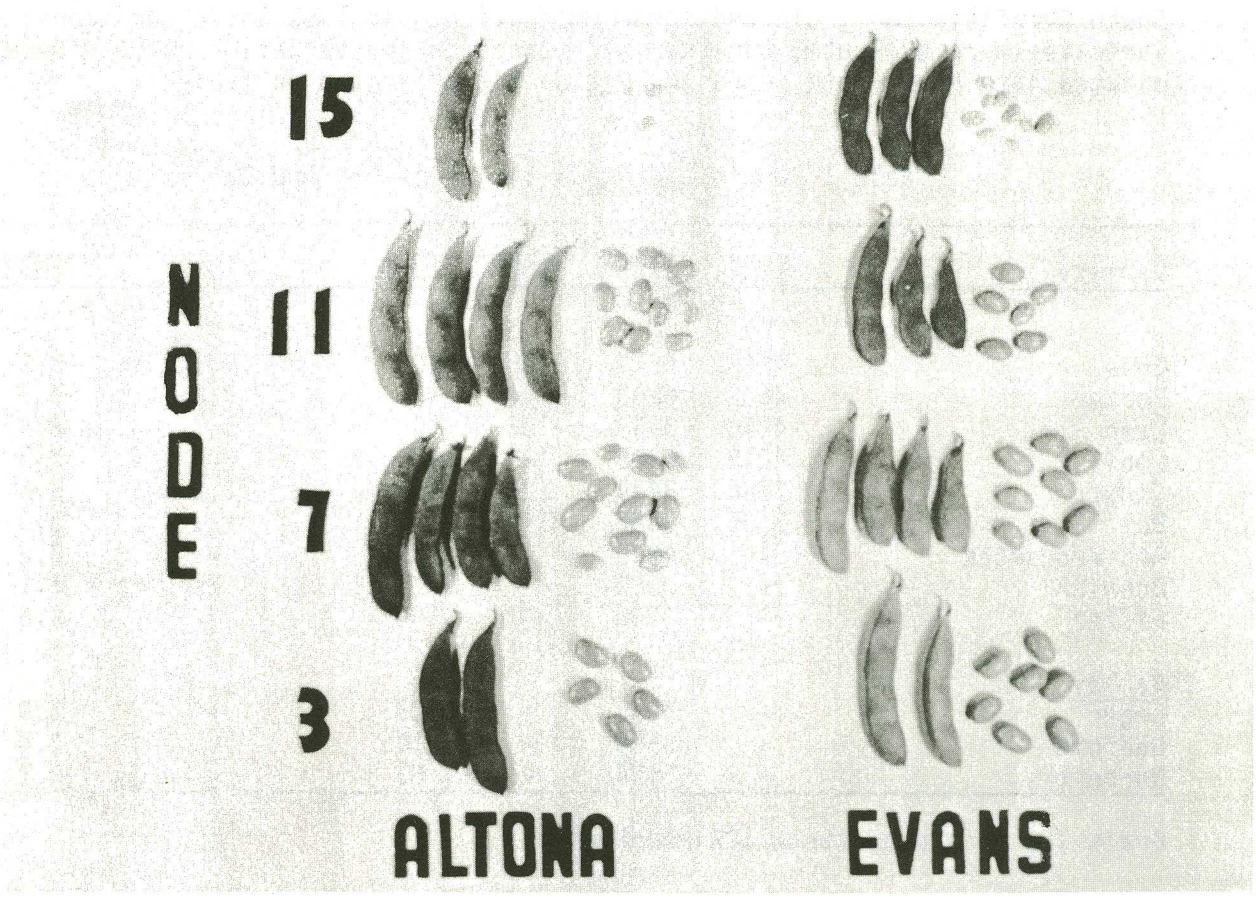

Figure 6. Seed size differences occurring on a single typical plant of Altona and Evans soybeans during seed filling.