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1) Yield components and development of several soybean varieties under various climatic conditions in Switzerland.

Our work on soybeans is intended to provide information bearing on the following questions: (1) Can soybeans be cultivated in our country at expenses tolerable to agriculture; and (2) if not, what must be undertaken in order to achieve this objective?

We would like to insert the soybean as a suitable leguminous plant in our crop rotation (in 1975, 61% of the fields in Switzerland were cultivated with small grains and 17% with corn) and to benefit from this rich source of protein (as animal and perhaps as human nutrition). The study of growth, development and morphological yield formation and of the effects of fructification are important in determining the agricultural potential of the soybean in Switzerland.

Our investigations with different varieties (Maturity Group 000-II) concerning yield formation and the development of several soybean varieties under various climatic conditions have shown that the economic returns, particularly in northern Switzerland and to a lesser degree in western Switzerland, are unprofitable. The plants form a good vegetative structure (stems, branches, leaves and nodes) under all the climatic conditions investigated. Vegetative development itself requires a rather high temperature sum until anthesis. Anthesis takes place only in the middle of July because of the cooler temperatures in north Switzerland; therefore only about 60-80 days and a relatively low temperature sum remain available for pod and seed formation and for the filling phase of the seeds.

The test of yield components under various climatic conditions has indicated large differences between cultivation sites. The yield potential, as determined by the number of flowers per plant, was available under all climatic conditions. For example, plants growing at the location having cooler temperatures demonstrated a clearly higher percentage of aborted flowers and pods. The complex questions concerning floral and pod abortion must be studied further, although investigations are considerably difficult due to the small size of the flowers.

The improvement of yield components of the soybean is desirable. Our intention was to analyze the most important yield components for use in a possible subsequent breeding program. Our results have indicated that an increase in thousand seeds weight leads to an increase in yield, while the other components are presumed to remain constant. Next to thousand seeds weight, which is relatively strongly influenced by genetics, early maturity must certainly be taken into consideration. The following factors must be studied within the scope of a breeding program: inheritance of yield components and particularly inheritance of the thousand seeds weight, as well as inheritance of days to anthesis and to maturity.

The varieties 'Fiskeby V' (Sweden, Maturity Group 000) and 0-52-903 (Ottawa Research Station, Maturity Group 000) reached full maturity under all the climatic conditions studied. Both varieties, however, showed a small economic yield. On the other hand, other varieties (e.g., 'Dunn' and 'Anoka', both from the U.S. and of Maturity Group I) indicated a high yield potential (higher number of pods per plant combined with a large number of seeds and a relatively high thousand seeds weight), under optimum growth conditions. The prerequisites for the cultivation of soybean under our climatic conditions do exist, inasmuch as it will be possible by means of actual breeding, to optimally combine the breeding objectives of early maturity, yield ability and reliability of yield.

The field trial experiments and especially those in the plant growth chambers, have indicated the great importance of cold tolerance of the soybean in Switzerland. A more or less strong decrease in temperature must be suspected each year under our climatic conditions. This decrease in temperature can have a very negative influence on yield formation and particularly upon the number of pods and seeds per plant. Such cold-tolerant forms are known and will be collected and tested. At the present time such cold-tolerant varieties are also being investigated in Switzerland from the standpoint of yield formation and development. With cold tolerant varieties it should become possible to sow at an earlier date and by this way gain an additional temperature sum for the reproductive development.

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2) Study on the technique of crossing as well as on the genetic behavior of quantitative characters of soybeans.

During three years (1972 to 1974), studies were conducted on the technique of crossing as well as on the genetic behavior of quantitative characteristics of soybeans [Glycine max (L.) Merr.] by means of crossing varieties. In growth chambers, greenhouses and in the open field, 3,282 crosses were made. The rate of successful crosses was 17.9%, 14.5% and 6.2%, respectively, for the different years.

During the year 1972, different methods for the crossing were tested, with the following results:

9.2%	Castration with immediate pollination with fresh pollen
0.0%	Castration with immediate pollination with pollen from exsiccator
3.0%	Castration, pollination one day later with pollen from exsiccator
4.4%	Castration, pollination one day later with fresh pollen
2.0%	Castration, pollination one day later with pollen not stored in exsiccator

The method first mentioned was the most effective one. The storage of pollen in the exsiccator reduced its viability. The environmental conditions greatly influenced the rate of success of the crosses. In the open field this rate fluctuated during the day as well as from day to day. The most successful period was from 0700 to 1000 and 1700 to 1900. In order to obtain more knowledge of the best environmental conditions, crosses were made in growth chambers at different temperatures (17°C, 22°C, 27°C, 32°C during the day, 12°C, 17°C, 22°C, 27°C during the night). The best result (36.3% successful crosses) was obtained with the combination of 27°C/22°C. The success of crossing was also greatly influenced by the relative humidity (70-80% is necessary); the basis of the success, however, is a careful selection of the pollen.

During the three-year period the following crosses between varieties were made:

- 'Magna' x 'Merit', 0-52-903 x 'Dunn', Magna x 'Gieso' with the aim of increasing weight of 1000 seeds.
- 0-52-903 x 'Anoka' with the aim of improving earliness.
- 'Fiskeby' x Anoka and Fiskeby x Dunn with the aim of reaching maturity very early.

We investigated the following parameters: number of tillers, number of pods in the lowest 10 cm of the main stem, number of nodes, number of pods and seeds per plant, height of the plants, beginning of flowering, maturity, yield and weight of thousand seeds and also number of pods per node, number of seeds per pod, lodging and growth-type.

It was generally found that the values for these parameters fluctuated considerably depending upon the year and place but also depending upon variety and type of cross. The genetic behavior is subject to changes; generally we observed an intermediate type of inheritance. Our criterion for selection in these studies, i.e., the selection of plants with the best and the worst components of yield in the F_2, was not correct; the environment had too great an influence.

All of the parameters considered were closely related. Based on the correlation coefficients, we can state that differences in the yield were due mainly to a variable number of seeds per plant (67-94%) as well as the weight of thousand seeds (3-24%). The number of seeds per plant is correlated to the number of nodes per plant, the number of pods per node as well as the number of seeds per pod and the weight of thousand seeds; the main part of the variance is due to the number of nodes per plant.

The heritability is high considering parameters at the beginning of flowering and at maturity.

References

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