been proven.

A bluish-purple pigment was extracted from seedcoats of L68-2073, a self-imperfect black Clark isoline. Paper chromatography revealed only one band of pigment. This band may be the same pigment as one of the bluish-purple bands in L67-3469, but more research is needed to prove or reject this hypothesis.

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1) Soybean breeding in Austria.

Introduction: Since Brillmayr (1929) published his first report on soybeans, there has been almost no intensive research on it in Austria. Its cultivation dropped gradually and then ceased completely after World War II, due to the increased import of American soybean products and the difficulty in producing varieties which suit Austrian conditions.

In 1970, the Institute of Agronomy and Plant Breeding, University of Agriculture, Vienna, started to renew interest in soybean and worked out a program to develop its cultivation, aiming to insert it as a suitable leguminous plant in the crop rotation, and to benefit from this rich source of

protein badly needed for animal and human nutrition.

The first problem was to find suitable varieties with a short vegetation period, not longer than 140 days; a high enough yield to be profitable for the producers; and good seed quality to fulfill the industrial requirements.

The investigations were carried on at the Institute's nursery in Vienna, and its Research Station in Großenzersdorf (25 Km from the University, 48°12' latitude, 16°34' longitude, elevation 153 m, mean rainfall per year 578 mm and the mean annual temperature 9.8°C).

The breeding program consists of: I—Germplasm collection: Since soybean is considered as an almost new crop in Austria, collection of introduced varieties formed a fundamental part of the breeding work. About 150 introductions from different countries (USA, Sweden, Japan, Brasil, Nigeria, Hungary, Czechoslovakia, Yugoslavia and West Germany) have been evaluated extensively and the promising entries were selected to form the basis of the major part of the breeding material. The local Austrian varieties introduce a very small portion of the genetic variability required for any breeding program and are impossible to depend upon.

II—Improving the agronomical treatments: The promising material was introduced in different field trials to evaluate its reaction to different agronomical treatments such as: way and method of sowing, plant density, time of sowing, depth of seeds, inoculation with bacteria, insecticides, herbicides, effect of temperature, photoperiod and supplementary irrigation on seed germination and yield potential, etc. The importance of such investigations is to throw light upon the norm of reaction of each entry "genotype", and to find out the best agronomical and environmental combinations which enable the genotype to express its maximum potential. Time of sowing, for example, affects the onset of blooming but not the ripeness and the harvest time. Early sowings gave the best results (Gretzmacher, 1974).

III—Selection: As already mentioned, since soybean is an almost new crop in Austria, simple and bulk selection from entries constitutes the major part of the work. The first information about any entry is always derived from single plants grown in single row plots. Promising simple or bulked plants were selected for further comparison trials using Latin square or randomized complete block design. In general, major emphasis was placed on

early maturity, yield, height, phenotypical seed quality, resistance to shattering and diseases, seed size, number of seeds per pod and number of pods per plant. No attention is being paid at present to the chemical composition.

IV—Induction of mutations: Three groups of seeds of different varieties were subjected to different dosages of X-rays during the period from 1970 until 1975, which can be summarized as follows:

1) Seeds of the German variety 'Caloria' "class 00" were treated in 1970 with 400, 600, 4000, 8000 and 12000 rad radiation, under the direction of the Atomic Research Center in Seibersdorf, Austria. Selection within and between the initial 60 strains was practiced annually for the characters previously mentioned. Out of this group of strains, only nine were still promising in 1975 and in the M_6 comparison trials. Minimum phenotypic differences were found between the selected strains and the original material. The relative degree of yield potential among strains was not consistent between successive generations. Besides controlled selection, the climatic conditions in the years during which the different generations were advanced resulted in extremely effective natural selection for maturity. Weiss, Weber and Kalton (1947) explained the inconsistency in yield potential among different breeding generations to be due to the late maturity which is alternately correlated with high or low yield depending upon seasonal conditions. In a collection of mutants selected for early blooming habit, it was noticed that the seasonal differences, especially thermophile, affect the blooming time more than the ripeness, and consequently the harvest time. These two characters seem to be independently directed; i.e., under warm environmental conditions these selected strains start to bloom earlier than under cold conditions, but the ripening time is still about the same. Johnson, Robinson and Comstock (1955) found that genotypic correlation between high yield and long period from flowering to maturity, lateness, heavy seed, resistance to shattering and lodging were appreciable in magnitude and suggested that they may be of practical value in selecting for high yield. Under Austrian conditions, it was noticed that multidimensional selection is slow but promising. In the following year some of the selected strains gave as high yield as 150% of the original control variety. This sudden increase had never been reached. Three superior strains are recognized as: ST 31, ST 53 and ST 59, and gave 151.5, 166.9 and 166.2% of the original mother sample's yield.

2) Seeds from four varieties, 'Caloria,' 'Altona,' 'Anoka,' and 'Portage,' were subjected to X-rays with dosages ranging from 12000 to 32000 rad. The highest doses were almost 50% lethal. The technique used and the characters selected were the same as in 1970. Two promising strains were obtained, AL 7202 and Ca 7218, which gave 115.7 and 108.0%, respectively, of the yield of their original ancestors. The differences in yield potential seem to be less heritable than those of other characters valuable to breeding purposes (Johnson, Robinson and Comstock, 1955a).

3) In 1975, seeds from another four varieties, 'Swift,' 'OS-289' (Yugoslavia), 'Manchu Wisconsin' and 'Iregi-Szürkebaralh' (Hungary), were subjected to another combination of X-ray dosages between 4000 and 16000 rad. These seeds will be sown this year.

V—Hybridization: Last year, 1975, some entries drew attention by being superior in one or more characteristics. A hybridization scheme was drawn, single plants were grown in pots, kept under glass house conditions with supplementary light to encourage blooming and normal growth. Crosses between some extreme plants were carried out. The number of suitable flowers was too little and about 60 crosses were completed. The F_1 seeds were sown the following summer under screen house conditions. The desired combinations were not yet found. F_2 seeds were harvested, and weighed but no segregation in seed coat color was observed. In the same summer of 1975, a large scheme program of crossing was planned and carried out. Five lines, single plants of 10 different entries and varieties, were sowed on two different sowing dates to elongate the blooming time and have a continual supply of flowers. About 300 crosses were made, representing almost all possible combinations. About 30 crosses were finally harvested. The F_1 seeds will be sown this year under screen house conditions. Major attention will be paid to back crossing the F_1 plants superior in the required characters. A normal large program for hybridization is scheduled for this year.

Summary: After a period of three decades, attention and interest has been renewed in soybean cultivation and breeding in Austria. The main problem is to find out the suitable initial material for breeding. This was practiced with the help of:

1) Germplasm collection from different countries.

2) Selection between and/or within introductions, especially for short

vegetation period to suit Austrian climatic conditions, plus the other economic characteristics.

3) Induction of mutations.

4) Hybridization.

Some strains originated by irradiation appear to be promising under the Austrian climate and seeds in small quantities are available for exchange.

Selection for yield from normal introductions seems to be also hopeful in spite of the difficulties cited above. The yield in comparison trials showed that the maximal yield increase obtained during the period 1970-1975 was about 15-24% due to varietal adaptability.

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1) Soybean linkage and allelism tests.

F_2 linkage results are presented in Table 1 with a = XY, b = Xy, c = xY, and d = xy for the gene pairs listed in the form of Xx and Yy. Percentage recombination was obtained as previously (Buzzell, 1974).

As reported previously (Buzzell, 1975), the T31 that I am using appeared to carry ln in contrast to the Ln T31 used by Weiss (1970). The F_2 results (Table 2) show that my T31 is ln the same as T41 which carries ln (Bernard and