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1) Soybean mutation.

Since 1970, soybean radiation experiments have been conducted in Thailand. The objectives are (1) to create genetic variability in soybean cultivars by gamma radiation, and (2) to screen and to evaluate for desired characteristics with the aim of producing superior breeding lines with resistance to diseases and insects.

The purpose of this presentation is to report briefly the results obtained within a period of 1970 to 1977.

In general, the soybean seeds with moisture content between 10 and 14 percent were irradiated with gamma rays from a caesium source at the Division of Radiation and Isotopes, Kasetsart University. The M_2 seeds of each M_1 plant were usually sown as plant-to-row. The mutants were detected in the M_2 generation.

Two experiments were carried out in order to find a gamma radiation dose suitable for inducing mutation in 'Sansai' and 'S.J.2' cultivars. The doses were varied from 5 to 35 krad. It was found in one experiment that the maximum frequency of yellow seedlings in the M_2 generation occurred at 15 krad treatments. With this 15 krad dose, it was possible to obtain changes in morphological characteristics in later soybean experiments (Smutkupt, 1973; Smutkupt, 1976b). In an experiment using Sansai, 'S.J.1', S.J.2, 'Wakashima', and 'Cutler-71', yellow seedlings were observed in all cultivars with mutation frequencies ranging from 0.09 to 0.53 percent. White-flowered mutants were obtained in the purple-flowered Wakashima with a frequency of 0.15 percent. White-flowered mutants were also observed in S.J.2. In brown-hilum cultivars, 0.09 percent black hilum mutants were observed in Wakashima and 0.14 percent in S.J.2, respectively (Singburaudom, 1977).

A lethal Sansai mutant with an extreme reduction in plant growth was obtained (Smutkupt, 1973).

In an experiment on cross pollination of white-flowered Sansai cultivar with two purple-flowered cultivars (S.J.1 and S.J.2), the natural outcrossing was not found in Sansai controls, but 0.04-0.18 percent of outcrossing were found in the Sansai plants grown from seeds treated with 15 krad (Jumnongnid, 1976; Jumnongnid and Smutkupt, 1977).

In respect to change in yield of mutant lines, it was not possible to obtain any single mutant line which yields statistical significantly higher than that of the control. The seed yield of mutants was always lower than that of the control (Chanmesri, 1975; Smutkupt, 1974; Smutkupt, 1975; Smutkupt, 1976a).

An increase in protein content was obtained in Sansai and S.J.2 mutants. The percentage of increment was approximately 2 to 3 percent (Smutkupt, 1975).

An increase, as well as a reduction, of about 1 percent oil content were observed in S.J.2 and Sansai mutants. In this experiment, the fatty acid composition of mutants and mutation-derived lines of both cultivars were determined. It was observed that there was 1 to 4 percent reduction of oleic acid in S.J.2 mutants, but a 2 to 6 percent increase in Sansai mutants. S.J.2 mutants had an increase of approximately 2 to 4 percent in linoleic acid and approximately 1 percent in linolenic acid. Conversely, Sansai mutants had approximately 2 to 4 percent reduction in linoleic acid and less than 1 percent reduction in linolenic acid (Chanmesri, 1975; Smutkupt, 1975).

The use of radiation as a tool for soybean improvement might be evident in an attempt to solve a problem of soybean rust, which is caused by Phakopsora pachyrhizi Syd. This is the most serious soybean disease in Thailand. A source of resistant genes for this disease is urgently needed. It is also very difficult to obtain the source in the germplasm collections.

In an experiment on the field evaluation on rust reaction in M_3 soybean lines, it was found that leaves on the upper third of the plants of three sub-lines derived from Line No. 123 (G 8375, and AVRDC accession), as well as one out of three sublines derived from Line No. 138 (Taichung), were infected with non-sporulating lesions (332). The leaves in the upper third of the plants of other sublines including control lines were heavily covered with sporulating lesions (343) (Smutkupt et al., 1978).

Soybean mutation experiments for inducing rust resistance are being carried out.

In conclusion, the data obtained from soybean radiation experiments show that gamma radiation can create variability in many characteristics of soybeans. However, when desired characteristics cannot be isolated from existing variability, then an attempt to create variability by radiation has considerable merit. Success in obtaining a desired characteristic, such as disease resistance, will depend largely on the effectiveness of screening techniques. The possibility of radiation-breeding as a useful tool for soybean improvement should not be overlooked.

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1) Observations of polyembryony and polyploidy in ms_1 and ms_2 male-sterile soybean populations.

Several reports of polyembryony and polyploidy in the progeny of ms_1 male-sterile soybeans have been made. Kenworthy et al. (1973) found 4% of 3485 seeds contained twin seedlings. Three triploids and one haploid were found among the twins. The seeds were from ms_1ms_1 plants of a locally adapted maintainer line. Palmer and Heer (1976) reported six sets of twins (2.9%) in 209 seeds examined. One twin plant was a triploid. Among 15 seedlings with abnormal cotyledons or roots, one was a tetraploid and eight had higher levels of ploidy; all other plants were diploid. The source of the seeds was ms_1ms_1 plants of 'Harosoy'. Beversdorf and Bingham (1977) obtained seeds from ms_1ms_1 plants of several genetic backgrounds and found 2.3% polyembryonic seeds in 7206. The frequency appeared somewhat lower in early maturing lines. A sample of 150 random monoembryonic seeds contained six (4%) triploids, but a sample of six small monoembryonic seeds contained five (83%) triploids. In addition, 61 monoembryonic seedlings that were from shriveled seeds or had germinated slowly produced nine triploids, two tetraploids, three pentaploids and two hexaploids.

The objective of our study was to obtain tetraploid plants for further study. Separate populations containing the ms_1 and ms_2 genes were surveyed. M1-MS78 contained bulked seeds from ms_1ms_1 plants from a composite population that was three generations removed from crosses of several adapted lines and varieties with N69-2774, the source of ms_1. M2-MS78 contained bulked seeds from ms_2ms_2 plants of a similar population derived from crosses of