An Induced Mutant Line Lacking the α-subunit of β-conglycinin in Soybean
[Glycine max (L.) Merrill]

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Summary
We identified a novel mutant line lacking an α-subunit. The line was obtained by subjecting to gamma-ray irradiation Kari-kei 434, a genetically fixed line with a low level of β-conglycinin which is characterized by the absence of the α'-subunit and low levels of both the α- and β-subunits of β-conglycinin, a major soybean storage protein. The mutant line which lacks both the α- and α'-subunits went through two generations without displaying any physiological abnormalities. We concluded that the induced trait characterized by the lack of the α-subunit is truly inherited.

Key Words: Glycine max, mutant, β-conglycinin, α-subunit, storage protein, gamma-ray.

Introduction
The major components of soybean seed storage proteins are glyccin (11 S globulin) and β-conglycinin (7 S globulin), which account for about 70% of the total seed proteins. The amount of sulfur-containing amino acids (methionine and cysteine) per gram of protein in glycycin is three to four times larger than that of β-conglycinin (Koshiyama, 1968) which is composed of α-, α'- and β-subunits (Thanh and Shivasaki, 1978). Furthermore, glycycin exhibits better processing properties in textu- rized and filmed soy foods as well as in tofu gels than β-conglycinin (Fukushima, 1991).

For these reasons, attempts were made to identify mutant soybean lines lacking with a low level of β-conglycinin. So far, Keburi, which is characterized by the absence of the α'-subunit, and Mo-shi-dou (Gong 503), which shows low levels of the α- and β-subunits, were identified in Japanese soybean germplasm collections (Kitamura and Kaizuma, 1981). The absence of the α'-subunit and the decrease in the levels of the α- and β-subunits are controlled by three respective alleles (Kitamura et al., 1984, Tsukada et al., 1986). By the use of the three alleles, lines with a low level of β-conglycinin have been bred without any physiological abnormalities (Ogawa et al., 1989). Therefore, we attempted to breed several lines with low levels of β-conglycinin lacking the α'-subunit and showing a low level of both the α- and β-subunits by using the alleles. Kari-kei 434 is one of the lines with a low level of β-conglycinin.

Recently, an induced mutant lacking both the α- and β-subunits was found in the progenies of irradiated Waseduzunari soybeans (Kaizuma et al., 1989). Another induced mutant showing markedly reduced levels of the α- and β-subunits was identified (Kitagawa et al., 1991). However, these mutants failed to grow up to maturity.

We attempted to obtain mutant soybeans lacking the α- and β-subunit by subjecting Kari-kei 434 to gamma-ray irradiation. The present paper reports the identification of a soybean line lacking the α-subunit along with the characterization of the line.

Materials and Methods
Ten thousand air-dried seeds of Kari-kei 434, a line with a low level of β-conglycinin which was characterized by the lack of the α'-subunit and a marked decrease of the level of the α- and β-subunits of β-conglycinin, were irradiated with gamma-rays at the Institute of Radiation Breeding, National Institute of Agro- biological Resources in Japan. The irradiation doses were 20 kR (1.0 kR/h), 30 kR (1.5 kR/h) and 40 kR (2.0 kR/h) for 2,000, 5,000 and 3,000 seeds, respectively. The irradiated seeds were planted at Kariwano Branch of Tohoku National Agricultural Experiment Station in the summer of 1991 to obtain M2 seeds. All the M2 seeds, which included 24,664, 6,732 and 6 M2 seeds irradiated with 20 kR, 30 kR and 40 kR, respectively, were harvested from individual M1 plants. To identify seeds lacking the α- and β-subunits, 9,334 individual M2 seeds, which included 6,128, 3,200 and 6 M2 seeds irradiated with 20 kR, 30 kR and 40 kR, respectively,
were analyzed by sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE), according to the method of Laemmli (1970), using distal portions of seeds.

Results and Discussion

Of the 9,334 M$_2$ seeds analyzed by SDS-PAGE, we identified only one seed lacking the α-subunit in a progeny of soybean irradiated with 20 kR gamma-ray. The mutant M$_2$ seed planted normally germinated, grew and matured to produce 56 M$_3$ seeds. Analysis of ten individuals of 56 M$_3$ seeds by SDS-PAGE showed that all of the ten seeds lacked the α-subunit (Fig.1). Therefore, we concluded that the induced trait characterized by the lack of the α-subunit is a truly inherited trait. In spite of the marked reduction of the β-conglycinin levels, soybean plants lacking both the α- and α'-subunits and exhibiting a low level of the β-subunit went through two generations without displaying any physiological abnormalities.

Ogawa et al. (1989) reported that the presence of glycinin may compensate for the decrease in the level of β-conglycinin to maintain the production of total seed protein in the lines with low levels of β-conglycinin. We observed a similar compensation for the marked decrease in the β-conglycinin level by the glycinin in our soybean lines with a low level of β-conglycinin. We assume that the amount of sulfur-containing amino acids could be increased in the seeds of the soybean lines with very low β-conglycinin levels.

To analyze the mode of inheritance of the trait and other properties of soybeans, further studies should be carried out.

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Literature Cited


