Variation in Flowering Time of Soybean after Irradiation.

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ABSTRACT

The polygenic variation in flowering time of soybean irradiated with Co^{60} gamma ray evaluated in the R_2 generation. The genetic variance in the irradiation treatment was about four times that of the control. The basic possibility of selection for the early and the late in flowering time of soybean after irradiated with Co^{60} was suggested in this paper.

INTRODUCTION

Since Muller and Stadler [3,9,11] discovered that ionizing radiations induce mutations, until now, there have been numerous attempts 'good mutants, in agricultural plants. Gustafsson [7,12,14,19] reported the development of an erecoides series of mutants in barley and Humphrey[20] obtained several strains of the Dorchsoy 2 variety of soybeans with increased vigor by irradiation of seed with thermal neutrons. Andersson and Olsson[18] developed Primex white mustard which is superior in yield and oil content. Frey[13,15] selected stem rust resistant mutants in oats.

Many of the improvements which have been made have resulted from mutations in the genes of small effect controlling quantitative characters, such as flowering time[6], maturity time and plant size.

In resent years, a number of workers have attempted to assess the variation induced in quantitative characters, and have estimated the progress that can be made by subsequent selection. All of this work has been concerned with selffertilized species.

Gregory [1,2] increased variation in yield of peanuts by mesns of X-irradiation. The mean yield of the progenies from the irradiated groups was considerably reduced, but selection of otherwise normal plants gave lines which out yielded the non-irradiated parent. Gregory [2] hypothesized that the normal appearing members of irradiated populations may be variously mutated with a large number of small individually inconsequential changes which, in the whole, form a sound basis for artificial and natural selection. As a preliminary exploration of this hypothesis, he estimated the total genetic variance and measured the effect of selection on the quantitative character yield among progenies of randomly selected normal-appearing plants from X-ray treated and control populations of Virginia Bunch peanuts. The estimated genetic variance of the irradiated groups was approximately four times that of the control group.

Oka[4] using X-irradiation, produced a symmetrical increase in variability for plant height and heading date of rice without altering the means for these characters. Selection for high and low expression of both characters was effective.

Rawling et al[7] irradiated soybean with X-ray and neutrons and demonstrated an increase in variation for yield, plant height, matuity time and seed size. They estimated a five-fold increase of genetic variance among the progenies from irradiated material. Mean yield was significantly depressed but mean maturity time, plant height and seed size were unchanged. They predicted gains from selection for all characters except plant height, but pointed out that predicted gains for yield were likely to be offset by the reduction in the mean.

Brock and Latter[9] increased variation in quantitative characters with irradiated subterranean clover, but no changed in the mean. The genetic varianse was about six times as large as that of control.

In this experiment, the polygnic variation in flowering time of soybean (Jangdanbackmok No.29 variety)irradiated with Co^{60} is reported.

MATERIALS AND METHODS

The variety of soybean, Jangdanbackmok No.29, was used in this experiment., Sample of foundation seed was exposed to Co^{60} gamma radiation from 12 Kr. R_1 is used to designate the generation produced by planting irradiated seeds, regardless of kind of radiation used, R_2 would be the next generation in sequencs.

R_1 and control plants were grown in 1967 and were harvested individually. The R2 seed was planted in plant progeny rows in 1968. Twenty plants were alloted to irradiated familly, ten were alloted to control and thirty plants were alloted to plot in R_2 generation. The randomized complete block design was designed with three replioations. The abnormal plants were removed and only apparently normal plants were included in the final statistic analysis. The data for character in variety was analyzed by an appropriate analysis of variance.

The estimation of pertinent mean square and parameter in analysis was as follow:

Source of variation	Mean square	Parameters estimated
Between famillies	M_1	$r\delta f^2 + \delta rf^2 + \delta e^2$
Famlliies x Reps.	M_2	$\delta rf^2 + \delta e^2$

δe^2 is error calculated from within plots mean square, δrf^2 is the tnteraction between famillies and repltcations,. δf^2 is the components of variance due to genetic differences between famiilles, and r is the number of replications.

RESULTS

The phenotypic distributions of flowering time between control and irradiated treatment are shown in Fig. 1. The mean of flowering time was 69.04 days for the control and it was 69.44 days for the irradiation.

The distributions were symmetrical about the means both in the control in the irradiation.

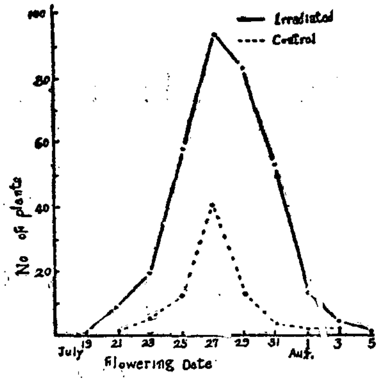

Fig. 1., The phenotypic distribution of flowering in R_2.

The analysis of variance of flowering time in the control and the irradiated treatment is shown in Table 1 and 2.

δf^2 is 0.17 in the control and is 0.64 in the irradiation. The genetic variance in the irradiation treatment is about four times that of the control.

Table 1. Analysis of flowering tim e(plot)

Irradiation Sources	S.S	d.f.	M.S.
Between plots	1358	59	23.09
Within plots	4101	561	7.31
Total	5459	620	8.804

Control Sources	S.S	d.f.	M.S.
Between plots	54	29	1.89
Within plots	1719	340	5.05
Total	1773	369	4.804

Table 2. Analysis of flowering time (Family)

Irradiation Sources	S.S.	d.f.	M.S.	
Between families	64.0	19	3.36	$\frac{\delta e^2}{n_0}+\delta rf^2+r\delta f^2$
Within famillies	16.5	2	8.25	
Famillies × Reps.	54.5	38	1.43	$\frac{\delta e^2}{n_0}+\delta rf^2$
Total	135.0	59	2.27	$\delta f^2=0.64$

Control Sources	S.S	d.f.	M.S.	
Between fami lies	18.7	9	2.07	$\frac{\delta e^2}{n_0}+\delta rf^2+r\delta f^2$
Within famillies	25.8	2	12.9	
Famillies × Reps.	27.8	18	1.9	$\frac{\delta e^2}{n_0}+\delta rf^2$
Total	72.3	29	2.4	$\delta f^2=0.17$

DISCUSSION

There is a common assumption that the radiation induced mutants are detrimental. But the purpose in order to use the mutants is to applicate in the usefulextent of irradiations.

In the early, numerous attempts to induce beneficial mutations have interested for the variations of major genes. However, the distributions indicate that increased genetic variation cannot be due to major genes, but due to large number of mutations of small effects. Therefore, the symmertrical increase of variation may be regarded as the indication of polygenic variation for quantitative character.

The symmetry of distribution also suggests that polygenic mutations with plus and minus effects occur equally frequently in both directions. The use of the variation in a control population as a reference has often limited value. However, two refere nces can be suggested. One is the comparison of radiation-induced variation with that generated by hybridization, and the other is the comparison of the extent induced variation with the range of the characters for other varieties of the species.

The variation for quantitative characters by intercrossing the varieties are well adapted to the local circumstance, but thus necessitating has a long, period of selection.

The symmetrical increase of genetic variace extents the range for selection without upsetting adaptation, thereby allowing artifical selection to be carried out on the particular characters of interest. In this experiment, the increasing of genetic variance in flowering time of soybean is suggested the basic possibility of selections for the early and the late of flowering time.

SUMMARY

The genetic variability in flowering time of soy bean irradiated was evaluated in the R2 generation in 1968. Seeds 'Jangdanbackmok No. 29, variety were exposed to 12 Kr. and the R_2 was planted in progeny rows from seeds were harvested individually in 1967 (R_1 generation) and replicated three times with randomized complete block design. The abnormal plants were removed and only apparently normale

plants were inculded in the final statistic analytis. The estimate of genetic variance in irradiation treatment was four times as large as that of the control. Possibility of selection for the early and the late in flowering time of soybean irradiated with Co 60 was briefly discussed as basic point of view.

摘 要

Co60 gamma 線 照射에 依한 長端白目 29號의 大豆 種子 開花期의 遺傳的 變異를 R_2에서 評價하였다. 種子는 12Kr로 照射 시킨후 R_1은 1967年 個體別로 採種하여 1968年 R_2를 養成하여 R_2에서 正常個體만을 分析에 包含 시켰다.
照射區의 遺傳分散은 標準區의 約4倍였다. 放射線 照射에 依한 大豆開花期의 早晩에代한 選拔에 基礎的材料가 될을 提示하였다.

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