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Induced Genetic Variability for Oil Content in Soybean

Ionizing radiations are known to induce the genetic variability for quantitative characters. The studies in peanuts[1] and soybean[2-5] have revealed that genetic variability could be increased and better types may be isolated subsequently. This study was therefore undertaken to estimate the extent of genetic Variability induced by gamma rays for oil content in soybean.

Samples of two hundred seeds of Bragg and Type-49 varieties of soybean were irradiated with 10, 15 and 20 Krad doses of gamma rays, a week before planting. These irradiated seeds along with the unirradiated controls were planted in split plot design with varieties as main plots and doses as sub-plots with three replications. Row to row distance was 60 cm and the rows were of 6 m in length. Eight seeds from each plant of M_1 generation of 10, 15 and 20 Krad treatments were taken and bulks were prepared to constitute the treatments. Planting was done in split plot design, using varieties (Bragg and Type-49) as main plots and 0, 10, 15 and 20 Krad as sub-plots with two replications. Each plot consisted of 5 rows (6 m long and 60 cm apart). Twenty five plants were tagged at about 15 days after germination. Oil content of seeds of every plant was determined by pulsed NMR technique at Nuclear Research Laboratory, New Delhi. Each sample was analysed in duplicate. The signals were recorded in triplicate for each sample and the oil content was then computed in percentage.

In order to test whether treated populations had significantly more variability for oil content as compared to their respective control populations in M_2 generation, the 'F' test was used. It was assumed that the control population could provide an estimate of environmental variability and the treated populations would include environmental as well as induced genetic variability. Heritability in broad sense was estimated only in those populations which had significant increase in variance over control, assuming the following model :

$$H\,(b) = \frac{\delta^2 P - \delta^2 E}{\delta^2 p}$$

Where, $\delta^2 p$ is total variance in treated population and $\delta^2 E$ is variance in control

The data on mean oil content in different irradiated and unirradiated populations of Bragg and Type-49 and the extent of variability along with broad sense heritability are presented in Table 1. Bragg had more oil as compared to Type-49. Analysis of variance indicated significant differences among doses. The variety × dose interaction was also revealed to be significant. The doses of gamma rays had significant increasing effect on oil content when averaged over both the varieties. However, when effect of different doses on both the varieties was closely looked into, it was found that the doses of 10, 15 and 20 Krad altered the oil content of only Bragg and not of Type-49 significantly indicating differential response of varieties to gamma rays for oil content. As compared to control the average oil content of treated Bragg was increased by 2 per cent. The intra-population variance of different irradiated populations were generally higher except in Type-49 treated with 10 Krad (Table 1). However, statistically significant increase was observed only in Bragg 20 Krad which had thrice the variability of Bragg control. When individual plant oil content of different treatments was looked keenly, the range of oil content in Bragg 20 Krad was found to be higher (17.1 to 26.0 per cent) with mean value of 22.7 per cent. Since variance of Bragg 20 Krad was significantly higher than its control the heritability in broad sense was calculated in this case only and it was as high as 69.2 per cent (Table 1). Interestingly, Type-49 did not show any significant increase in variance for oil content after irradiation.

TABLE 1 : *Variability for oil content (%) in different irradiated populations of Bragg and Type-49 in M_2 generation*

Variety	Treatment (Krad)	Mean	Range	Variance	Heritability (b)
Bragg	0	20.5	20.4—21.1	0.508	—
	10	22.6*	20.5—23.0	0.551	—
	15	22.4*	21.1—23.1	0.523	—
	20	22.7*	17.1—26.0	1.650**	69.2
Type-49	0	19.8	19.1—21.0	0.777	—
	10	20.0	19.2—21.1	0.684	—
	15	20.3	19.4—21.3	0.836	—
	20	20.2	19.5—21.4	0.788	—

*, **Significant at 5% and 1% level of significance, respectively

Papa and Williams[4] observed a great deal of variability for protein and oil content in soybeans. The broad sense heritability was 69.2 per cent in Bragg 20 Krad population which also was in agreement with estimates made earlier by Williams and Hanway[3] in irradiated populations (70.3 per cent). They attributed sterility caused by irradiation to be the cause of change in chemical composition of soybean seeds. They noted that estimates of genetic variance and heritability for protein content were reduced in X rayed Hawkeye, when the sterile plants were excluded. However, the genetic variance was significantly greater though reduced by 26 per cent and heritability was decreased from 74 to 67 per cent. The increase in mean oil content of Bragg 20 Krad in M_2 generation resulted from a multitude of micromutations mainly in positive direction. The results of this study showed a positive change in mean oil content of Bragg 20 Krad. The existence of higher variability and heritability indicate the possibility of selection for improved oil content in soybean.

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