GAU Res. J. 1990, 16 (1) : 23–26

Gamma-Ray Induced Variability in Isabgul (*Plantago ovata* Forsk)

Diwaker R. Patel and K. C. Dalal

Medicinal and Aeromatic Plant's Scheme, Gujarat Agricultural University, Anand Campus, Anand-388 110

ABSTRACT

Dry seeds of Isabgul (*Plantago ovata* Forsk) variety Gujarat Isabgul-1 were irradiated in nitrogen atmosphere with gamma rays (10, 15, 20, 40, 80 and 100 kr) at BARC, Trombay. The plant progenies in M_2 generation were studied. Positive significant shifts in means were observed for the characters, length of spike and numbers of trillers per plant. Mutagenic treatments of gamma rays increased variability in M_2 generation in the progenies of most of the doses for most of the characters. The highest value of GCV accompanied by corresponding genetic parameters were observed at higher as well as lower doses of gamma rays for different characters.

(Received on 17th Jan. 1989)

INTRODUCTION

For our country, isabgul is one of the crops having high export potential. Because of it's high quality husk and bold seed, Indian Plantago (*P. ovata* Forsk) is preferred over European Plantago (*P. Psyllium* and *P. indica*). In north Gujarat, where isabgul is grown, occurance of few showers during December to early April is not an uncommon phenomenon. Even light showers during late March to early April, the time when husk formation on the seed is in process and the crop is about to be harvested, shatter the seed completely and thus the farmer loses his crop totally or partially. In Isabgul, spikes do not mature synchronously. During years when unusual cool weather prevails during later part of March, relatively heavy dew formation (which is absorbed by hygroscopic husk) occurs and subsequently seed shattering from mature spikes has been observed. In case of the above shown nature's unusual phenomenon, a late maturing variety may solve some of the porblems. However, in the available germplasm, there does not exist much variability including that for maturity and synchronous flowering. It was thought to create genetic variability first through mutagens because it is a heritable one and that response to selection is also good.

MATERIAL AND METHODS

Dry seeds of Isabgul variety Gujarat Isabgul-1 were exposed to 10, 15, 20, 40, 80 and 100 Kr. of gamma rays in nitrogen atmosphere at BARC, Trombay, Bombay. The irradiated seed material was sown in experimental plots alongwith control to raise M_1 generation. The M_2 generation was raised in

compact family design with three replications taking irradiation dose as main plot and progenies as sub plot during Rabi 1978-79. Each progeny line consisted of 50 plants in a row of 4.3 meter length. Seven competitive plants from each progeny were selected and observations were recorded on yield per plant, days to maturity, length of spike, number of tillers per plant and percentage of noneffective spikes per plant. Mean values were statistically analyzed. Genetic co efficient of variation (GCV) and heritability (h^2) in broad sense (in percentage) were calculated using standard formulae.

RESULTS AND DISCUSSION

Significant shift in means were observed for days to maturity, length of spike, no. of tillers per plant at all the six doses of gamma rays; for yield per plant at 15, 40 and 100 kr. doses and for total number of spikes per plant at 10, 15, 40 and 80 kr. doses of gamma rays (Table-1). Positive and negative shifts in means observed could be attributed to either plus or minus mutations. The lack of significant shift in means observed for percentage of noneffective spikes per plant could be due to cancellation of the effect produced in positive and negative directions.

TABLE 1.

Estimates of mean values and genetic parameters of 6 characters in gamma irradiated M_2 progenies.

Irradiation dose	*Range*	*Mean*	*G. C. V.*	*P. C. V.*	h^2
(1) Yield per plant (gms)					
10 kr	2.7 — 9.3	5.59	24.5	24.8	97.0
15 kr	4.5 — 9.9	7.19*	18.2	19.2	89.6
20 kr	3.3 — 7.2	5.35	23.5	23.8	97.5
40 kr	5.1 — 8.5	6.74*	15.6	16.0	95.4
80 kr	2.1 — 9.9	5.90	32.2	32.4	98.8
100 kr	3.6 — 9.9	6.24*	24.3	24.7	97.1
Control	4.9 — 6.3	5.67	—	—	—
(2) Total No. of spikes per plant					
10 kr	34.0 — 90.2	59.7*	20.8	21.5	94.3
15 kr	53.5 — 118.8	75.8*	23.0	23.6	94.9
20 kr	34.4 — 79.6	55.2	18.9	19.6	93.6
40 kr	50.0 — 116.6	78.4*	24.0	24.4	96.9
80 kr	21.4 — 91.0	61.3*	26.6	26.4	97.3
100 kr	25.3 — 74.8	53.3	23.9	24.5	95.8
Control	11.6 — 61.9	54.7	—	—	—

1.	2.	3.	4.	5.	6.
(3) Days to maturity					
10 kr	103.0 — 106.7	104.7*	0.87	0.92	90.0
15 kr	111.9 — 115.4	113.7*	0.62	0.68	83.8
20 kr	98.2 — 100.4	99.7*	0.57	0.61	87.4
40 kr	95.1 — 98.3	96.8*	1.07	1.09	95.8
80 kr	94.0 — 96.6	95.2*	0.61	0.66	86.5
100 kr	104.0 — 107.4	105.9*	0.63	0.65	93.1
Control	106.0 — 111.0	109.6	—	—	—
(4) Length of spike (cms)					
10 kr	3.1 — 4.8	3.9*	5.0	6.9	52.3
15 kr	3.6 — 5.0	4.1*	3.4	5.2	42.8
20 kr	3.0 — 6.1	3.8*	6.4	9.2	48.7
40 kr	3.1 — 4.7	4.0*	3.9	6.5	34.9
80 kr	3.1 — 4.9	3.8*	4.3	7.3	34.8
100 kr	3.1 — 4.9	3.9*	9.3	10.1	85.1
Control	3.1 — 3.8	3.4	—	—	—
(5) No. of tillers per plant					
10 kr	2.7 — 5.6	4.1*	5.2	9.8	28.6
15 kr	3.3 — 6.3	4.3	7.8	10.9	51.3
20 kr	3.3 — 5.0	4.1*	3.8	7.1	27.9
40 kr	3.0 — 5.8	4.2*	7.1	10.4	46.5
80 kr	2.2 — 5.6	4.0*	7.7	10.4	49.0
100 kr	3.1 — 5.0	4.1	3.2	7.9	16.1
Control	3.0 — 3.6	3.2	—	—	—
(6) Percentage of non-effective spikes per plant					
10 kr	10.5 — 28.5	15.5	0.0	7.8	0.0
15 kr	10.2 — 26.2	18.4	4.7	6.6	50.5
20 kr	10.0 — 25.2	13.8	6.7	8.4	65.3
40 kr	10.6 — 24.2	15.5	11.2	11.9	97.6
80 kr	10.1 — 27.8	14.1	9.9	11.6	72.9
100 kr	10.1 — 22.3	14.4	0.0	7.7	0.0
Control	11.8 — 18.6	16.0	—	—	—

* Significant at 5% level.
GCV = Genetic coefficient of variation.
PCV = Phenotypic coefficient of variation.
h^2 = Heritability.

Increased range in irradiated populations as reported by Bhatia and Swaminathan (1962) was either due to increased recombination arising from crossing over near the centromere region or mutation in the polygenic system.

Mutagenic treatments of gamma rays induced genetic variability in all the doses in most of the characters studied. However, the treatments did not induce genetic variability at 10 and 100 kr for percengage of non-effective spikes per plant. The highest values of GCV accompanied by corresponding genetic parameters were observed both at higher and lower doses of gamma rays for different characters : at 15 kr for number of tillers per plant, at 40 kr for days to maturity and percentage of non-effective spikes per plant, at 80 kr for yield per plant and total no. of spikes per plant and at 100 kr. for length of spike. Hebetineka (1973) also reported such variable response of different quantitative characters to the mutagenic treatments of gamma rays in barley. He concluded that the frequency of mutations at different loci was variable. Therefore, a mutagenic treatment effective for causing variability for one quantitative character might not be as effective for another. The difference would be due to the no. of loci governing a quantitative character.

The characters, yield per plant, total no. of spikes per plant and days to maturity exhibited very high heritability indicating that these characters are under additive genetic control and selection for these traits would be highly effective. The characters with low heritability indicated that these characters are highly influenced by environmental fluctuations and selection for their improvement would not be effective.

ACKNOWLEDGEMENT

The authors are grateful to the Director, BARC, Trombay, Bombay for providing radiation facilities and Director of Campus, Gujarat Agricultural University, Anand Campus, Anand for providing facilities for conducting field experiment. The first author acknowledges the financial assistance provided by Isabgul Manufacturers' and Exporters' Association, Siddhpur for pursuing his M. Sc. (Agri.) studies.

REFERENCES

Bhatia, C. and Swaminathan, M. S. 1962. Induced Polygenic variability in bread wheat and it's bearing on selection procedure. Z. Pflanzenzucht. **48** (4) : 317-26.

Hebetineka, J. 1973. Changes in the variability of some quantitative characters in spring barley (*Hordeum vulgare* L.) induced by the combined action of gamma-rays and ethylmethane sulphonate on seeds. Sbornik Vysoke Skoly Zemedelske V. Praze. A No. 1 : 133-148.