SCREENING FOR ESTIMATING OPTIMAL DOSES OF COMBINED CHEMICAL AND PHYSICAL MUTAGENS

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Screening for optimal doses of mutagens for new pea cultivars has been carried out at our station for some years. In 1978 an experiment was set up to compare the effects of chemical and physical mutagens and their combined action. Three cultivars producing the highest seed yield were selected (viz. 'Finale', 'Paloma', 'Kaliski') and their dry seeds subjected to fast neutrons and NEU at doses as follows:

Nf	200 r	350 r	500 r
NEU	0.014%	0.022%	0.030%
Nf/NEU	200/0.014	200/0.022	200/0.030
	350/0.014	350/0.022	350/0.030
	500/0.014	500/0.022	500/0.030

and controls.

The effectiveness of particular doses was estimated on the basis of plant response in Mi and frequency of chlorophyl mutations in young Mo plants. In Mi the following features were recorded: emergence rate, length of stem with 2-5 and 4-5 leaflets, pollen grain viability (acetocarmine method), seed yield/plant, number of pods/plant, number of seeds/plant/pod, weight of 1000 seeds, and survival of plants. In M1 chlorophyl defects and deformations of meristem tip showing in abnormal stem development were observed. It was decided to statistically analyze the results to find the possible relationship between these injuries and the viability of pollen grains.

In Table 1 measurements of stem length with 4-5 leaflets are presented. This developmental stage seemed to best exemplify the reducing effects of mutagens. In all but one cultivar (Kaliski, 200 r) each irradiation dose caused pronounced shortening of stem as compared to the controls. Also, differences among cultivars were observed, e.g. the responses of cv. Kaliski to Nf and NEU were similar, while the cv. Paloma, contrary to the cv. Finale, seemed to be more susceptible to fast neutrons. Soaking of seeds in NEU solution after irradiation caused considerably more pronounced shortening of stems as compared to effects of separate mutagens.

Pollen grain viability (Table 2) was observed to be more decreased with the increase of Nf than that of NEU doses. The differences will have to be statistically proved; however, the results are likely to be insignificant in many instances despite very high and differential doses.

Table 3 shows the number of plants which produced seeds. The survival of plants treated with fast neutrons was not decreased with the increase in mutagen doses; sometimes it was even higher than in the controls. The exception was Paloma, where at 500 r the survival was distinctly decreased (80% of controls) In contrast, soaking in NEU decreased the survival by approximately 50%. The above is in agreement with the higher sensitivity observed for the cv. Paloma to Nf and that of the cv. Finale to NEU.

The effects of NEU were also readily observed at combined mutagens. At the highest dose (500r/0.030%) only 25% produced seeds as compared to the

controls. Considering the feature under discussion as determining the number of families in M_2, the results obtained may be used for estimating the doses and number of seeds to be involved in the treatment.

It seems that a thorough analysis of all results will provide grounds for estimating the level of combined mutagen doses for new cultivars. It is planned that the next stage of the experiment will involve comparison of Nf and NEU and of combined mutagens effectiveness.

Table 1. Length of stem with 4-5 leaflets expressed in % control.

Cultivar	Control	Nf			NEU			Nf/NEU 200r			Nf/NEU 350r			Nf/NEU 500r		
		200r	350r	500r	.014%	.022%	.030%	.014%	.022%	.030%	.014%	.022%	.030%	.014%	.022%	.030%
Paloma	100	97.8	75.6	51.1	90.0	55.6	63.3	73.3	66.7	61.1	60.0	50.0	46.7	44.4	35.6	33.3
Finale	100	86.2	75.0	65.0	82.5	70.0	53.8	72.5	65.0	58.8	66.2	56.2	50.0	36.2	32.5	32.5
Kaliski	100	103.6	83.9	62.5	92.8	82.1	60.7	78.6	64.3	58.0	67.8	57.1	48.2	44.6	37.5	36.6

Table 2. % Pollen grain viability.

Cultivar	Control	Nf			NEU			Nf/NEU 200r			Nf/NEU 350r			Nf/NEU 500r		
		200r	350r	500r	.014%	.022%	.030%	.014%	.022%	.030%	.014%	.022%	.030%	.014%	.022%	.030%
Paloma	98.5	88.6	81.4	79.2	92.9	92.1	84.9	86.1	89.5	85.9	82.9	81.9	79.6	70.2	72.5	70.8
Finale	99.4	91.3	88.9	88.1	91.9	88.7	87.5	87.6	90.7	89.2	88.1	87.3	78.3	78.1	66.6	65.7
Kaliski	99.3	95.9	80.5	72.7	96.0	95.7	83.3	87.3	89.1	89.3	81.8	88.8	84.9	78.0	76.8	78.7

Table 3. Number of plants with seeds expressed in % control.

Cultivar	Control	Nf			NEU			Nf/NEU 200r			Nf/NEU 350r			Nf/NEU 500r		
		200r	350r	500r	.014%	.022%	.030%	.014%	.022%	.030%	.014%	.022%	.030%	.014%	.022%	.030%
Paloma	100	100.1	98.8	80.7	97.4	70.3	54.9	77.7	51.5	48.7	71.6	55.1	32.6	56.6	38.7	28.5
Finale	100	91.3	101.2	104.6	98.7	78.0	47.3	84.7	61.4	55.5	108.4	66.8	59.0	52.2	35.0	25.9
Kaliski	100	104.9	98.7	98.4	98.8	70.4	52.0	82.6	68.0	56.2	80.7	56.8	47.2	63.8	38.5	34.8