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A NEW SUNFLOWER MUTANT FORM

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SUMMARY

Dry dormant seeds of sunflower cultivar VNIIMK - 8931 were irradiated with 150 Gy gamma rays (Co^{60}). The influence of the mutagen was determined in the M_1 generation. In the M_2, M_4 and M_5 generations there were plants with lightly yellow cotyledons which died. Some mutated plants were isolated and self pollinated for several generations. New sunflower forms with inherited changes were obtained through selection and self pollination. One of the new forms was characterized by modified leaf and leaf petiole characters. The leaves were light green, lustrous, with a well expressed veir. The leaf edges were serrated and runcinated with sharp points. The petioles had a joint near the leaf blade. The plant form was similar to an ornamental cabbage type. These plants had other important characters which were of interest for selection. This mutant has been noted as M 95-674. It can be used as an ornamental form as well as for heterosis breeding.

Key words: Sunflower, mutant, gamma rays, breeding, self-pollination.

INTRODUCTION

Ionizing radiation influences different organisms causing physical, chemical and biochemical changes (Panojan, 1971). Researchers have used ionizing radiation to induce mutations for developing new genetic potentials. Gamma rays used in genetic investigations and in the development of initial material for sunflower breeding are important for treating seed, pollen and plants.

Kovacik (1973) suggested that the depression level for development and growth of plants obtained by seed treatment with gamma rays was determined by the period from the treatment to the sowing date of the treated seeds.

Savin and Stepanenko (1968) showed that the plants treated with doses of 10 Gy gamma rays at 8-10 true leaf stage had a rapid growth and increased productivity at the expense of high specific seed weight and stem length. As a result, it could be possible to obtain short-stem forms. Tsvetkova (1970) obtained the highest percentage of useful mutations when pollinating with pollen ionized with 10 Gy X-rays on plants, obtained from seeds ionized with 65 Gy gamma rays. Zezjulinskii et al.(1969), Tsvetkova (1970), Saadat et al.(1974), Sarafi et al.

(1974), Sarafi and Amirshari (1976), Christov (1990) reported on the influence of gamma rays and the many inherited mutations. New sunflower forms have been obtained with changes in the size and phenotype of the plant, size, form and color of leaves, head and seed size, and oil content (Zezjulinskii et al., 1969; Tsvetkova, 1970; Ivanov and Ivanov 1985; Christov, 1990; 1995). These were of interest for sunflower breeding program at IWS "Dobroudja". This paper examines new sunflower forms, characterizing some of these new morphological characteristics.

MATERIALS AND METHODS

This study was a part of a more extensive program treating seeds from several sunflower cultivars and lines with different doses of gamma radiation. New mutant seed material of VNIIMK 8931 cultivar was produced using gamma rays with doses of 150 Gy. Seeds were planted in the field a day after treating. Untreated seeds were used as check. The trial was carried out in a randomized block design with two replicates.

During the vegetative period, phenological observations were made for every M generation. These observations included 1000 seed weight and oil content in seed. The female fertility of plants was determined by the amount of seed obtained from open-pollinated heads. The self-compatibility was determined by self-pollination of plants. The inflorescences of M_1 plants were covered with protective bags for self-pollinated M_2 plants. Some M_2 heads were sib-pollinated as a group. The seeds of each head were planted as an individual generation. The plants of the third generation were isolated and self-pollinated. The seeds of each head of the next five generations were planted as a separate progeny and the plants were self-pollinated. Inbred line 2607 was used as a check.

RESULTS AND DISCUSSION

No depressive effects on M_1 plants were observed as a result of ionizing gamma-rays. Several plants with short, light yellow stripes onto the leaves were obtained, but the number of shorter plants was greater than the check. In M_2, some of the plants had light yellow cotyledons, which soon after germination got darker with the plants dying. These chlorophyll mutants were observed in M_4 and M_5. The group pollination of the M_2 plants was done with the aim to avert any plant damage. In the M_3 generation, there were no differences between plants, but in M_4, M_5 and M_6 some differences appeared. There was some influence of pollination in the M_2 group for the diversity. The disintegrative results in M_4, M_5, M_6 and in M_7 proved the heterogeneous nature of some characters. The

treatment with gamma rays caused changes in plant height, head diameter, colour, form and indentation, oil content, and vegetation period.

Table 1: Characteristics of mutant sunflower forms originating from seeds of cultivar VNIIMK 8931 treated with 150 Gy gamma rays, 1995

Mutant N	Plant height (cm)	Head diameter (cm)	Leaves length/width (cm)	Petiole length (cm)	1000 seed weight (g)	Oil content (%)	Vegetation period (days)
670	115	25	24 / 21	12	93	38.40	106
671	135	28	28 / 26	12	74	45.63	116
672	125	25	28 / 26	12	76	43.31	114
673*	150	26	23 / 22	16	48	43.35	108
674*	153	26	24 / 22	16	51	42.54	108
675	154	29	30 / 25	15	82	43.40	112
676	165	28	26 / 23	14	103	43.56	111
678	165	28	27 / 25	15	92	45.72	115
679	160	23	27 / 25	16	78	45.48	115
680	162	22	27 / 26	15	82	37.74	118
681	140	22	28 / 25	15	99	39.24	111
VNIIMK 8931	215	29	31 / 29	22	73	41.81	126
Peredovik	205	28	32 / 29	22	87	44.83	124
L - 2607	138	20	21 / 20	17	65	40.51	110

By transferring genes for some characters in homozygous condition by repeated continuous selection and self-pollination (Scheme 1), the fixed material was obtained for M8 plants. The mutant forms with large leaves - dark or light green, slightly or deeply serrate, with long or short petioles predominated. The forms with short and medium high stems also predominated. Most of the mutant material possessed very good self-fertility, increased seed set, or average vegetation period, average seed size and high oil content (Table 1). The obtained mutant forms were not morphologically distinguishable from the well-known cultivars and lines except one. This mutant was obtained in M6 in 1993 (Scheme 1). In 1995 it was planted in the field and named after 673 and 674 numbers. The difference between this mutant (Figure 1) and VNIIMK - 8931 (Figure 2) and the other mutants, (Figure 3) was due to the morphological characteristics of the leaf and leaf petioles.

The leaves were light green, lustrous with protuberant mid-vein. Their margins were deeply serrated with long denticles, ending with sharp spires. The petioles had a joint near the mid-vein (Figure 4). The plants' phenotype before flowering was more similar to a cabbage than a sunflower.

Scheme 1. Mutant sunflower forms, obtained from treated seeds of VNIIMK 8931 cultivar with gamma rays (150 Gy), 1988

N	M8		M7		M6		M5		M4		M3		
	Height cm	oil %	Height cm	Oil %	Height cm	Oil %	Height cm	Oil %	Height cm	Oil %	Height cm	Oil %	N
670)	115	38.40	110	43.54	130	43.58	140	34.70	170	40.70	165	34.49	(91
671)	135	45.63	115	43.85	135	42.63							
672)	125	43.31	100	44.57									
673)	150	43.35	100	43.39	135*	48.75	175	43.30	160	41.60	170	35.53	
674)	153	42.54	120	41.68									(94
675)	154	43.40	110	45.60	130	44.14	130	36.60	150	44.80			
676)	165	43.56	120	44.05									
677)			120	41.04	125	46.80							
678)	165	45.72	120	47.16									
679)		45.48	115	46.41	155	46.10							
680)	162	37.74	125	37.11	150	40.72	185	36.90	160	36.10	170	41.47	(97
681)		39.24	110	41.11	150	36.09	150	37.30					

* - New type of mutant plant.

Figure 1. Mutant N 674

Figure 2. VNIIMK - 8931 cultivar

Figure 3. Mutant plants of cultivar VNIIMK -

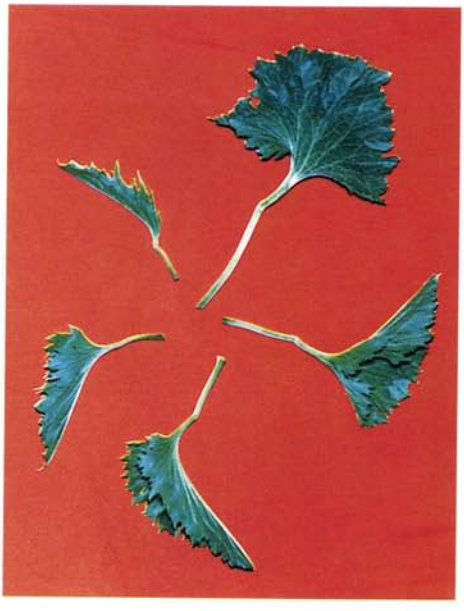

Figure 4. Leaves of mutant N 674

The new characters appeared in M6 and were not modified in M7 or M8. That indicated that these characteristics were inherited. Their late appearance was due to a recessive gene control. The invisible genetic changes were phenotypically displayed shortly after transferring these genes into the homozygous condition. The simultaneous display of all visible changes as mutant characters means that maybe the genes determining them were linked or were transferred by chance simultaneously into homozygous condition.

Plants stems were erect, not too thick, and light green. The inflorescence was normal. Its position is showed in Fig 1. This mutant is distinguished with very good self-fertility and the seed set in self-pollination under isolation was 33 to 72%.

The open-pollinated seed set reached 95 to 96%. The seeds were smaller rather than normal, with black hull. The data of some important characters are presented in Table 1 (N 673 and 674). The mutant was named M-95-674.

CONCLUSION

This study showed that genetic changes in sunflower plant could be obtained by gamma rays. The most interesting mutant form had unusual leaves and leaf petioles. It possessed other important agronomic characters such as very good self-fertility. The plants' height, inflorescence size, seed size, oil content and the vegetation period were similar to those of the best cultivated sunflower lines, including heterosis.

The sterile analogue development of the new mutant commenced in 1995. The results of this investigation showed that the new mutant M-95-674 could be used as an ornamental form.

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NUEVAS FORMAS MUTANTES DE GIRASOL

RESUMEN

Semillas secas de girasol del cultivar VNIMK-8931 fueron irradiadas con 150 Gy rayos gamma (Co^{60}). La influencia del mutágeno fue determinada primeramente en M_1. En M_2, M_4 y M_5 hubo plantas con cotiledones ligeramente amarillentos que murieron. Algunas plantas con caracteres nuevos fueron aisladas y autofecundadas varias veces. Como resultado de la selección y la autofecundación se han obtenido nuevas formas de girasol con cambios heredables.

Una de las nuevas formas estuvo caracterizada con cambios heredables en las hojas y peciolos. Las hojas fueron de color verde claro, brillantes y con nervaduras pronunciadas. Los bordes fueron serrados y con puntas agudas. Los peciolos tuvieron nódulos y curvados a la altura de la lámina de la hoja. La forma de la planta fue similar a una col ornamental. Estas plantas tuvieron otros caracteres importantes que fueron de interés para la selección. El número legal de este mutante es M 95-674. Puede ser usado como una forma ornamental así como para mejora para heterosis.

NOUVELLE FORME DE MUTANT CHEZ LE TOURNESOL

RÉSUMÉ

Les graines sèches dormantes du cultivar VNIIMK-8931 ont reçu une irradiation de 150 Gy par rayonnement gamma (Co60). L'effet mutagène a été déterminé d'abord en M1. Dans les M2, M4 et M5 des plantes à cotylédons jaune pâle qui n'ont pas survécu, ont été détectées. Quelques plantes présentant des modifications de caractères ont été isolées et autofécondées plusieurs fois. Au terme de la sélection et du processus d'autofécondation on a obtenu de nouvelles formes de tournesol avec des caractères héritables.

Une des nouvelles formes de tournesol est caractérisée par des modifications héréditaires de la feuille et du pétiole. Les feuilles sont vert-pale, brillantes avec des nervures bien visibles. Les bords sont dentés avec des pointes étroites. La forme de la plante est similaire à celle d'un chou décoratif. Ces plantes ont d'autres caractéristiques importantes, intéressantes pour la sélection. Le numéro offieciel de ce mutant est M 95-674. Il peut être utilisé tant comme forme ornementale que pour la sélection de l'hétérosis.