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PHENOTYPIC CHARACTERIZATION OF *CHRYSANTHEMUM CORONARIUM* AND ITS DIFFERENT MUTANTS IN YEAR 2012-13

RENU & SHANT LAL

Department of Horticulture, G. B. Pant University of Agriculture & Technology,

Pantnagar, Udham Singh Nagar, Uttarakhand, India

ABSTRACT

The study was conducted in phenotypic characterization of *Chrysanthemum coronarium* and its different mutants at Model Floriculture Centre of the University during year 2012 - 2013. Seeds of *Chrysanthemum coronarium* were treated with various doses of gamma rays (Cobalt-60) at National Botanical Research Institute, Lucknow. Immediately after the mutagenic treatment, the nurseries were raised and further transplanted in the field. M_1 population of *Chrysanthemum coronarium* treated with different doses of gamma rays were screened and characterized. The experimental materials selected for the present investigation consisted of 22 mutants (M_2) lines of *Chrysanthemum coronarium*. Data on phenotypic characterization conducted for various vegetative and floral traits revealed that there is a significant variation among different mutants and species *Chrysanthemum coronarium* used for the study of various phenotypic parameters. Result of quantitative analysis revealed that minimum plant height was found in mutant Co_{13} (23). Mutant Co_{8} (11) showed maximum leaf length and leaf area , mutant Co_{7} (88) had maximum leaf width and leaf area, mutant Co_{5} (55) exhibited maximum flower head diameter, ray floret length and width, mutant Co_{11} (131) recorded maximum flower head weight and disc floret weight. Whereas, flower disc diameter and flower head height were found maximum in mutants Co_{10} (26) and Co_{3} (59) however, mutants Co_{3} (63) and Co_{2} (5) had maximum number of ray florets and ray floret weight respectively. Whereas, results of qualitative analysis exhibited that four mutants like Co_{4} (1), Co_{4} (67), Co_{4} (88) and Co_{1} (9) were different from their parents as they had variation in form (semi-double and double) and colour (yellow group) of the flowers.

KEYWORDS: Phenotypic Characterization, *C. Coronarium* and Mutants

INTRODUCTION

Among the flowers, chrysanthemum is a popular flower crop of commercial importance. *Chrysanthemum* belongs to family Asteraceae or Composite also called the aster, daisy, or sunflower family. It has approximately 1,620 genera and more than 23,600 species (Stevens, 2001). In India, 900 species in 167 genera (Hajra *et al.* 1995) are reported. It is popular commercial cut flower but also grown as pot plant (pot mum). In international florist's trade, chrysanthemum ranks third as a cut flower and fifth as pot plant (Anonymous, 2008). The genus *Chrysanthemum* is characterized by annual or perennial herb or woody nature. *Chrysanthemum coronarium* is the commonest of all annual chrysanthemums. It is a leafy, vigorously growing robust and hardy herbaceous annual, with much branched and erect stem which imparts bushy appearance. It can be cultivated as an ornamental plant in the garden for border planting or in background of flower bed and blooms can be used as cut flower.

The ornamental industry strives for novelty to generate new products at competitive prices. Mutation is a method by

which novelty can be created in already well established cultivar. There is no visual difference between artificially produced induced mutants and spontaneous mutants found in nature. For the past 40 years, the International Atomic Energy Agency has sponsored extensive research and development activities on mutation induction to enhance the genetic diversity which have resulted in official release of over 2,700 new crop varieties in some 170 species. These mutants have created tremendous economic impact in agriculture throughout the world (http://www-mvd.iaea.org, 2012).

Induced mutagenesis in chrysanthemum is the most successful story. Mutants are phenotypic ally different from parental variety only in flower color/shape and leaf variegation (Datta, 1988). New ornamental plant varieties are continuously being created by breeders in response to consumer demand for new products. Growers also look for plants with improved agronomic traits, such as increased number of florets, flower size, flower diameter, yield and resistance to plant pathogens or herbicides. A large number of new flower color/type and chlorophyll variegated mutant varieties have been developed worldwide and commercialized.

MATERIALS AND METHODS

The present investigation was conducted at the Model Floriculture Centre, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, District Udham Singh Nagar (Uttarakhand) during the year 2012 - 2013. Pantnagar is situated at the foothills of Himalayas at 29^0 North Latitude and 79.3^0 East Longitude. The altitude of the place is 243.84 m above the mean sea level. In the present investigation, Seeds of *Chrysanthemum coronarium* was treated with various doses of gamma rays (Cobalt-60) at National Botanical Research Institute, Lucknow. Immediately after the mutagenic treatment, the nurseries were raised and further transplanted in the field. M_1 population of *Chrysanthemum coronarium* species treated with different doses of gamma rays were screened and characterized. The mutant lines of species, *C. coronarium* was grown under open field conditions by raising nursery on seed beds and then transplanting about 30 days old seedlings at 50 cm X 30 cm spacing. The experiment was laid out in a randomized block design with three replications. Soil of experimental site was brought to a fine tilth by two deep ploughing and leveled properly. All weeds and left over crop residue were removed. The field was divided into three blocks, each block having 36 plots for allotment of various treatments. Each individual plot consisting of 30 plants in 6 row of 1.5 m long. The seeds of *chrysanthemum coronarium* species were sown on raised nursery beds during second week of September and seedlings (about 30 days old seedling at four leaf stages) were transplanted in experimental plot on October, 2012. Depending upon the requirements, hoeing was done. Staking was done in plants which were prone to lodging. Plants were supported with the help of the wooden stakes. Wooden stakes are fixed at side of the plant to give them proper support and also protect the plant from the wind. The various observations were recorded on two middle row plants of species *Chrysanthemum coronarium* and its selected mutants.

RESULTS AND DISCUSSIONS

Phenotypic characterization of *C. coronarium* and its different mutants were presented in Table 1 and Table 2.

Significant variation in different quantitative traits which represented in Table 1 revealed that the maximum plant height (115.33 cm), leaf spread (E-W) (74.17 cm) and (N-S) (71.90 cm) were found in species *C. coronarium* (Cco) while, minimum plant height was found in mutant Co_{13} (23), 43.85 cm while, mutant Co_3 (1) showed the minimum plant spread (E-W), 45.59 cm and (N-S), 36.33 cm. Reduction in plant height of all the mutants than control is due to the inactivation of auxin content with increase in radiation dose which also depend on nature and extent of chromosal damage (Banerji and

Datta, 2002). Data and Gupta (1980) observed significant reduction in plant spread in Chrysanthemum. Similarly, Banerji and Datta (1990 and 1992) also recorded significantly less number of branches per plant and plant spread. The maximum leaf length was found in mutant Co_8 (11), 6.64 cm which was statistically at par with mutants, Co_3 (63), Co_1 (9), Co_3 (59) and mutant Co_7 (88) while, significantly higher than other mutants. Minimum leaf length was found in mutant Co_{12} (3), 3.35 cm. The maximum leaf width was found in mutant Co_7 (88), 5.40 cm while, minimum leaf width was found in Co_{13} (7), 2.16 cm. This might be due to the reduction of plant growth which may be caused by physiological, morphological and cytological disturbance due to gamma radiation (Gaul, 1970). Gamma rays significantly reduced the leaf length and width in chrysanthemum varieties 'Sonar Bangla', 'Satish Modi' and 'flirt' (Zargar *et al*., 1998). Mutants Co_7 (88) and Co_8 (11), 12.82 cm, exhibited maximum leaf area which was statistically at par of mutant Co_7 (16) and significantly higher than other mutants. The maximum number of flowers per plant was found in *C. coronarium* (Cco), 45.84 no. which was statistically at par with Co_2 (5) while, minimum number of flowers per plant was found in mutant Co_{12} (3), Co_{13} (7), 20.55 no. Similar findings were obtained by Gupta and Jugran (1978) in chrysanthemum. The maximum flower head diameter was found in Co_5 (55), 8.40 cm which was statistically at par of Co_2 (5) and significantly higher than other mutants whereas, minimum flower head diameter was found in Co_4 (88), 4.08 cm. These findings were in line agreement of Banerji and Datta (1990) in chrysanthemum as they observed the significant reduction in survival, number of branches, leaves and flower head size as compared to the control. Mutant Co_{10} (26) had maximum flower disc diameter, 3.70 cm which was statistically at par of species *Chrysanthemum coronarium* (Cco) whereas, minimum flower disc diameter was recorded in mutant Co_3 (1), 0.15 cm. The maximum number of ray florets was found in mutant Co_3 (63), 454.42 no. In case of disc florets, species *Chrysanthemum coronarium* (Cco), 470.27 no. had maximum number of disc florets while, mutant Co_1 (9), 5.83 no. recorded minimum number of disc florets. These findings were in close agreement with Srivastava *et al*. (2007) who reported that the gamma irradiation treatments adversely affected number of florets per spike and floret diameter. Mutant Co_{11} (131) showed maximum flower head weight, 5.44 g and disc floret weight, 2.35 mg while, maximum ray floret weight was found in mutant Co_2 (5), 35.73 mg. Mutant Co_5 (55) recorded maximum ray floret length, 3.51 cm and ray floret width, 1.72 cm. The maximum flower head height was found in Co_3 (59), 4.41 cm which was statistically at par of Co_1 (9), Co_3 (63) and Co_{13} (45) while significantly higher than others. Whereas, mutant Co_2 (5) showed minimum flower head height.

CONCLUSIONS

The results of qualitative analysis were presented in Table 2 which revealed that mutants Co_4 (1), Co_4 (67), Co_4 (88) had double type flower while mutant, Co_1 (9) had semi-double type flower and all these mutants had variation in flower colour as they come under the yellow group which was matched with the Royal Horticulture Society Colour Chart (RHS, 1966) whereas, original species *C. coronarium* (Cco) was single type and had white colour flowers. So these mutants were different from their parents which might be due to the changes in chromosomal aberrations, break down of phosphate metabolites, accumulation of free amino acids and change in the gene sequence. However, the radio-sensitivity of the variety is dependent upon the genotypes (Datta, 2001). Chromosomes number and chromosomes fragmentation are usually responsible for colour changes in case of chrysanthemum yellow flowered bud sport arise from white flower cultivars (Dowrick and El-Bayoumi, 1966). The change in flower form was also recorded by Lamseejan *et al*. (2003) in chrysanthemum with the chronic and acute gamma irradiation treatment. Misra *et al*. (2003) developed one chrysanthemum mutant with tubular florets by gamma irradiation while the original florets were flat spoon shaped.

Table 1: Phenotypic (Quantitative) Characterization of *C. Coronarium* and its Different Mutants

Species	Year (2012-13)																
	Plant height (cm)	Plant spread (E-W) (cm)	Plant spread (N-S) (cm)	Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2)	Number of flowers/plant	Flower head diameter (cm)	Flower disc diameter (cm)	Number of ray florets	Number of disc florets	Flower head weight (gm)	Ray floret weight (mg)	Disc floret weight (mg)	Ray floret length (cm)	Ray floret width (cm)	Flower head height (cm)
Cco	115.33	74.17	71.90	5.80	2.79	6.85	45.84	7.15	3.51	25.44	470.27	3.46	15.43	2.16	3.13	0.85	2.59
Co_1(9)	61.00	54.15	47.14	6.53	4.62	12.04	40.30	5.47	2.26	289.23	5.83	3.09	7.00	0.99	1.90	0.84	4.32
Co_2(5)	61.41	63.93	59.48	5.23	3.35	9.59	44.89	8.28	2.32	68.15	207.96	4.73	35.73	1.87	3.12	1.06	0.87
Co_3(1)	53.95	45.59	36.33	6.17	3.57	10.89	23.25	4.49	0.15	315.14	9.62	3.72	12.95	0.96	1.54	0.68	3.91
Co_3(59)	61.88	46.40	39.54	6.35	3.57	10.98	30.75	6.39	0.23	412.22	15.29	4.51	15.50	0.96	1.77	0.96	4.41
Co_3(63)	65.33	62.12	55.53	6.60	4.60	11.57	25.44	6.45	0.27	454.42	13.77	4.14	15.52	1.15	1.93	0.98	4.30
Co_4(1)	60.54	65.17	55.19	4.48	3.26	10.86	23.85	4.54	1.67	222.51	72.07	3.29	9.95	1.11	1.68	1.22	0.98
Co_4(67)	75.97	65.28	54.76	5.38	3.66	11.48	25.30	4.40	1.86	145.51	69.21	3.83	8.88	1.17	1.51	0.98	2.15
Co_4(88)	84.81	66.47	56.69	5.76	3.87	11.48	22.35	4.08	1.66	167.58	71.22	3.15	8.62	1.44	1.50	1.12	2.40
Co_5(55)	71.43	64.92	58.40	5.40	3.27	11.28	32.51	8.40	2.71	182.67	312.17	2.94	15.28	1.56	3.51	1.72	3.39
Co_7(16)	55.30	55.09	60.30	5.77	4.34	12.40	25.11	6.39	1.84	140.84	150.22	3.17	15.59	1.93	1.92	0.78	2.44
Co_7(88)	61.76	60.15	58.07	6.33	5.40	12.82	22.53	6.60	2.29	135.45	10.54	2.53	13.34	1.44	1.81	0.85	2.65
Co_8(5)	65.30	59.19	55.26	5.84	2.98	11.54	28.43	5.49	1.44	134.36	148.54	2.74	11.41	0.90	1.84	0.53	3.53
Co_8(11)	69.86	60.22	57.17	6.64	3.54	12.82	38.14	6.44	1.75	140.87	160.33	3.58	12.56	0.95	1.77	0.94	3.74
Co_{10}(24)	45.57	46.67	44.70	4.50	3.19	8.27	25.38	5.33	3.24	75.10	312.68	2.87	10.61	0.87	1.62	1.08	2.14
Co_{10}(26)	48.71	49.51	47.78	5.55	3.54	8.92	30.36	6.18	3.70	170.33	439.03	3.13	12.30	0.95	1.75	1.30	2.84
Co_{11}(56)	59.68	52.23	40.26	4.50	2.62	8.98	20.80	6.19	1.95	180.51	225.53	5.18	16.30	1.83	2.30	1.45	3.35
Co_{11}(131)	46.27	54.50	48.30	5.52	3.30	9.49	30.33	6.35	2.55	212.62	349.35	5.44	16.78	2.35	2.50	1.33	3.47
Co_{12}(3)	53.49	65.10	55.72	3.35	2.20	7.88	20.55	4.39	0.38	301.35	50.55	2.50	4.93	0.92	1.54	0.84	3.26
Co_{12}(97)	55.14	66.78	56.45	4.46	3.25	8.47	23.61	5.96	0.46	414.52	68.75	3.23	6.44	0.97	1.90	0.94	3.81
Co_{13}(7)	51.04	55.16	53.44	5.15	2.16	10.58	20.55	5.49	0.59	269.32	30.71	1.90	6.80	0.95	1.75	0.92	4.16
Co_{13}(23)	43.85	54.81	51.79	4.35	3.84	11.24	35.37	6.37	0.63	315.52	31.34	2.22	6.84	0.96	1.55	0.87	4.16
Co_{13}(45)	45.07	53.58	51.65	4.52	3.26	11.81	33.34	5.37	0.57	312.59	35.00	2.62	6.78	0.97	1.87	0.91	4.18
GM	61.42	58.12	52.86	5.40	3.48	10.53	29.08	5.92	1.65	221.14	141.73	3.39	12.41	1.27	1.98	1.00	3.17
S.Em.±	0.72	0.81	0.68	0.14	0.11	0.16	0.50	0.12	0.08	2.93	1.50	0.09	0.23	0.04	0.07	0.04	0.08
CD at 5%	2.06	2.32	1.94	0.41	0.32	0.47	1.44	0.35	0.24	8.36	4.28	0.26	0.66	0.12	0.22	0.12	0.23

Table 2: Phenotypic (Qualitative) Characterization of *C. Coronarium* and its Different Mutants

S. No.	Name of Species/Mutant	Flower Form	Flower Colour	Flower Size
1.	*C. coronarium*	Single	White	Large
2.	CO $_1$(9)	Semi-double	Yellow orange group 14 D	Large
3.	CO $_2$(5)	Semi-double	White	Large
4.	CO $_3$(1)	Double	White	Large
5.	CO $_3$(59)	Double	White	Large
6.	CO $_3$(63)	Semi-double	White	Large
7.	CO $_4$(1)	Double	Yellow group 9 D	Large
8.	CO $_4$(67)	Double	Yellow group 8 D	Large
9.	CO $_4$(88)	Double	Yellow group 2 D	Large
10.	CO $_5$(55)	Semi-double	White	Large
11.	CO $_7$(16)	Semi-double	White	Large
12.	CO $_7$(88)	Double	White	Large
13.	CO $_8$(5)	Semi-double	White	Small
14.	CO $_8$(11)	Double	White	Large
15.	CO $_{10}$(24)	Double	White	Large
16.	CO $_{10}$(26)	Semi-double	White	Large
17.	CO $_{11}$(56)	Semi-double	White	Large
18.	CO $_{11}$(131)	Semi-double	White	Small
19.	CO $_{12}$(3)	Double	White	Large
20.	CO $_{12}$(97)	Semi-double	White	Small
21.	CO $_{13}$(7)	Double	White	Large
22.	CO $_{13}$(23)	Double	White	Large
23.	CO $_{13}$(45)	Double	White	Large

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