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Madras Agric. J. 79 (8) : 443 - 447 August 1992 https://doi.org/10.29321/MAJ.10.A01777

RADIATION INDUCED MUTATIONS IN CHINESE POTATO

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ABSTRACT

Effects and efficiency of gamma ray treatments on induced variability for yield contributing traits were studied in Chinese potato (Coleus parviflorus Benth), in which lack of morphological variability has been observed in the germplasm collection made so far. Underground tubers weighing 1.5 g/tuber of accession number CP 11 were treatment with 1 kR, 2 kR, 3 kr and 4 kR gamma rays. Besides tubers weighing 3 g and 6g/tuber were also treated with 3 kR gamma rays. The study indicated that the growth reduction in MV1 generation was linear, with increasing dose of gamma rays and the 50% growth reduction (LD50) dose observed was with 3 kR gamma ray treatment. From the study more than 50 different morphological solid mutants were obtained representing variability for plant structure (new ideotype), leaf size and shape, flowering and tuber characters.

Chinese potato (Coleus parviflorus Benth), a starchy aromatic tuber crop, is widely cultivated in South India, Sri Lanka, Indonesia and parts of Tropical Africa. It is reported as an amphidiploid in origin and contains 68 (2n) chromosomes (Ramachandran, 1968). Germplasm resources indicate that the genetic variability for yield and yield contributing traits in the crop is very meager. Moreover, there is no seed production in the crop, though there is plenty of flower formation. Published reports towards the use of induced

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mutations in the crop are limited. An attempt was made to induce variability in yield and yield contributing traits in Coleus through gamma rays.

MATERIALS AND METHODS

A local cultivar, CP 11, of Coleus **parviflorus** was used. Small underground tubers numbering 200 each weighing 1.5 g/tuber were irradiated with 1, 2, 3 and 4 kR gamma rays at a dose rate of 1000 R/23 seconds in a gamma ray chamber. Besides, larger tuber weighing 3 g and 6 g numbering 200 each were also treated with 3 kR gamma rays. Gamma irradiated tubes were planted in the nursery in three replications with a spacing of 20 x 20cm between plants and rows in RBD design.

Sprouting was recorded on 20th and 30th day after planting. On the 30th day after planting. On the 30th day, height of the plant, number of sprouts, internode length, leaf length and leaf width were recorded from 10 plants per replication randomly selected from each treatment. The sprouts which were showing different pattern of growth, colour etc were removed at 3-4 leaves stage and were raised in a second field nursery with a spacing of 40 x 40cm between plants and lines. After attaining 30 days of growth, cuttings were taken from the solid mutants raised in the second field nursery and were grown in rows consisting 5 plants/row with a spacing of 40 x 30cm between rows and plants. Recommended cultural practices were undertaken to ensure a good crop stand. Mutation frequency was calculated on MV1 plant basis and on the number of MV1 sprout basis.

RESULTS AND DISCUSSION

Gamma irradiation effect : Percentage germination was reduced linearly with increasing dose of gamma rays and the maximum reduction observed was 52% with 4 kr gamma rays treatment (Table 1). A similar trend was observed in cases of delay in sprouting with various treatments as compared to the control. The treatment population also showed a linear reduction in plant height, internode length, leaf length and leaf width as compared to the control population. The mean number of sprouts observed were 3.92, 5.84 and 6.3a deriving from 1.5g, 3g and 6g tubers

TABLE 1 : Percentage Sprouts, Plant Height, Internode Length, Leaf Length, Leaf Width in Coleus following gamma ray Treatments

Treatments	Sprouting %		Height	Internode length	Leaf length	Leaf width
	20 days	30 days				
1 kr	64	68	7.1	1.9	4.7	3.2
2 kr	56	60	6.5	1.9	4.8	3.1
3 kr	42	54	4.7	1.3	3.8	2.8
4 kr	38	48	3.6	0.8	2.9	1.7
CONT	100	100	9.2	2.6	8.6	4.7

TABLE 2 : Gamma ray Induced Mutation Frequency Represented on MVI Plant basis and on MV1 Sprount basis in Different Tuber Size in Coleus.

Treatment	Number of mutants			Mutation		Frequency (%)	
	No. of plants	No. of sprouts	Sprouts plant	Plants	Sprouts	Plant basis	Sprout basis
1 kr	170	617	3.6	3	4	1.8	0.64
2 kr	146	521	3.6	5	8	4.1	1.53
3 kr	110	431	3.9	14	19	12.7	4.40
4 kr	86	352	4.7	12	18	13.9	5.11
CONT (1.5 g)	98	473	4.8	-	-	-	-
3 kr (3 g)	123	719	5.8	13	22	10.6	3.06
3 kr (6 g)	131	827	6.3	12	24	9.2	2.90

respectively with 3 kR treatment as against 4.82, 6.82 and 8.80 in their controls (Table 2). The present study also indicates that the ID 50 dose was around 3 kR gamma rays, as in this treatment plant height, internode length etc. showed approximately 50% reduction as compared to the control.

Mutation frequency : Though, 4 kR treatment registered maximum morphological mutation frequency (13.9%) the greater frequency of beneficial morphological mutants with reduced lethality was in the 3 kR gamma ray treatment. After 1 kR gamma ray treatment the induction of morphological mutants was negligible and largely light chlorina types were found. However, one leaf variegated mutant with leaf margin having yellow and whitish pigments could be isolated from 1 kR gamma irradiated population. This mutant showed all characters similar to the control including flowering, except the leaf variegation. Table 2 also indicates that there is "dilution effect" in 3 kR treatment of 6g tubers where the number of sprouts were the number of sprouts were maximum 827 which might have contributed to reduced mutation frequency (9.2%), though the number of sprouts with mutations recorded were 24 as against 19 in 1.5 g/tuber with the same treatment.

Morphological mutant : Handling of treatment population as mentioned in "Materials and Methods" instead of waiting for the MV2 generation for mutant screening, as usually practiced in mutation breeding programme, resulted in the isolation of more than 50 solid mutants which were morphologically distinct from each other. Few of them are listed below with their easily distinguishable traits.

Mutants	Habit	Leaf	Inflor escence length (cm)	Flowers	Tuber	Duration	Nos.
CP.11 (control)	Spreading Planting June-July (Seasonal)	Petiolate, oval, green, hairy, serrated	15-20	Light blue Flowering after 90 days after planting	Cylindrical on stems & at the base	150-160	-
I. Structural type	1. Spreading	Sessible, smooth	10-15	Blue	Oval	150-160	2
	2. Erect of compact suited to late planting	Spoon shape and light yellow	30-40	Dark blue flowering after 45 days	Elongated	120-130	1
	3. Semierect	Normal	10-20	Small, whitish	Oval	140-150	1
II. Leaf type	1. Semierect	Seassible, yellowish	20-30	Normal	Oval	150-160	1
	2. Semierect	Nesette dark green, margin pinkish	10-15	Dark blue flowering after 60 days	Cylindrical	130-140	1
	3. Spreading	Small, pinkish	5-10	Rudimentary	Oval, yellowish	130-140	1
	4. Semi-erect	Margin entire pinish	10-15	Small blue	Sperical tuber at the base	140-150	1
	5. Spreading	Variegated leaf	15-20	Normal	Cylindrical light colour	150-160	1
Flower type	1. Semi-erect	Normal	20-25	Blue, early flowering	Oval	120-130	1
	2. Spreading	Normal	-	non-flowering	Sperical	-	3
	3. Semi-erect	Normal	-	Non-flowering	nil	-	6
Tuber type	1. Spreading	Normal	10-15	Dhurts	Round large tuber	150-160	2
	2. Semi-erect (tuber production round the year)	Normal	15-20	Whitish	Oval, tuber only at the base	120-130	2
	3. Semierect, shorter stem tuber production round the year	Small, thickness sessation	5-10	Light blue	sperical tuber, at the base only	100-110	1

Improvement of vegetatively propagated plants through induced mutations has been attempted in many species (Lapins, 1973; Powell, 1976; broertjes and Van Harten, 1978). Moreover, where there is propagation only by means of vegetative parts and no seed production the improvement can only be achieved through induced somatic mutations. In the present study, **Coleus** has responded well to gamma irradiation treatment as it is evident from the study that the growth reduction is liner with the increasing dose as reported in various crops. Moreover, mutation frequency also shoed a positive trend, a 'dilution effect' with increasing size of the tuber. It is interesting to note that high amount of morphological mutants. However, some showed mericlinal nature with the change of flower colour. Such enormous amount of variability must have been induced probably due to the reasons that either the initial cells in the meristem formation may be few or the adventitious bud formation may be responsible for the high amount of solid-mutant sprout production as reported by Broertjes and Van Harten (1978). Besides, the influence of ploidy on the yield of mutations in vegetatively propagated plants varies considerably, as with increased ploidy, the number of mutant gene loci that can be heterozygenous increases translating into a greater number of possible mutant traits recoverable viz mutation breeding (Broertjes et al. 1980).

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