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INDUCED MORPHOLOGICAL MUTANTS IN *OCIMUM SANCTUM L.*

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The seeds of the *Ocimum sanctum* L. were treated with various doses/ concentrations of physical (gamma rays) and chemical (SA and EMS) mutagens. In all 11 morphological mutations were isolated in the M_2 and M_3 generations. These morphological mutations were characterised on the basis of the part of the plant body affected. Among them, the important mutants are high yielding, early flowering and high photosynthetic rate.

Keywords : Characterisation; Morphological mutants; *Ocimum sanctum.*

Introduction

Ocimum is a versatile genus comprising of about 150 aromatic plant species[1], offering rich source of essential oils and aroma chemicals, useful to the perfumery industries. *Ocimum sanctum* L. has a punget, bitter taste and is used as stomachic, anthelmintic, alexiteric and antipyretic. It is useful in diseases of the heart and blood, leucoderma, asthama, bronchitis, vomiting, foul smells and pains. It is also used in eye and purulent discharge of the ear. The root decoction is given as a diaphoretic in malerial fever. The plant also helps in keeping the atmosphere clean. This property is because of its ability to absorb poisonous or pollutant gases and evolve ozone. It is due to ozonolysis process, performed by the component known as 'Citral', present in the leaves. Citral also has peculiar oxidative property which leads to a reaction, in which an aldehyde undergoes oxidation, ultimately to form ozone. Interestingly, the process of ozone formation takes place more prominently, during night hours. The whole process is regulated by an enzyme cyclooxygenase[2].

Although, the plant has tremendous potentials as a medicinal plant an air purifier but still no systematic attemts have been made to improve plant types for these traits. Mutation breeding approach appears to be of specific advantage to *Ocimum sanctum* L. because induction of mutation creates variability in the populations. The beneficial mutations, associated with other desirable characters, can be exploited directly. In the present investigation, mutations were induced in the *Ocimum sanctum* L. by treating the seeds with different mutagens *viz.*, gamma rays, SA and EMS and different morphological mutations, isolated in the M_2 and M_3 generations, were characterised.

Materials and Methods

Genetically pure seeds of *Ocimum sanctum* L. were procured from nursery of Dadadham Ravi-Nagar, Nagpur. Hundred dry and healthy seeds were subjected to 200, 400, 600 and 800 Gy doses of gamma rays at the dose rate of 100 Gy per minute; at the Post-graduate Department of Chemistry, Nagpur University Campus, Nagpur, using a ^{60}Co source. Two chemical mutagens (SA and EMS) were also used to induce the mutations. In this case, dry as well as seeds presoaked in distilled water for 5 and 10 hours were subjected to the mutagen treatment. These seeds were treated with 20 ml aqueous solution of 0.001, 0.002 and 0.003% of SA or 0.1, 0.2 and 0.4% of EMS, for 18 hours at 22±1°C.

The chemically treated seeds were post-soaked in 50 ml distilled water. The mutagen treated were immediately sown in pots in Green house, to raise the M_1 population. At six leaf stge seedlings were transplanted in the field with proper spacing in the rows. The seeds of the M_1 plants were collected plantwise, and again sown in the field, to raise the M_2 generation. The M_2 population was screened for the presence of morphological mutations. Most of the M_2 mutants were found to breed true in the M_3 generation. The morphological mutations were characterised on the basis of growth, development and reproductive performance.

Results and Discussion

All the 3 mutagens were found to be effective in inducing a broad spectrum of mutations. Gamma rays were found to be most effective, followed by SA, and finally EMS, in that order. However, gamma rays, produced a relatively narrow specturm of mutations, as compared to both chemical mutagens. The broadest specturm of morphological mutations was produced by SA and it was closely followed by EMS. A total of 11 different morphological mutants were isolated in the M_2 and M_3 generations (Table 1). These mutants were characterised on the basis of the following characters.

Large Leaf : In the gamma ray, as well as, chemical mutagen treated M_2 populations, plants with leaves much larger than, that of control, were isolated. The average leaf area, in mutagen treated population was higher than control and ranged in between 27.0 to 36.88 cm^2 while the average leaf area, in control was lower and ranged from 14.50 to 24.03 cm^2.

Small leaf: In M_2 populatin of SA treatment, plants with smaller leaves than the control were isolated. However, in gamma ray and EMS treated M_2 populations, small leaf mutants were not observed. The average leaf area, in small leaf mutants, ranged between 11.7 to 14.20 cm^2.

Unbranched : In the mutagen treated M_2 population some plants with only main stem and no branches were recorded. Such mutants were named as 'Unbranched mutants'. These mutants were found in the physical, as well as chemical mutagen treated M_2 populations.

Profused branching : In these plants, the number of branches were 22 to 30, while in control it was 10 to 20. These mutants were found in the physical as well as chemical mutagen treated M_2 populations.

Tall : These mutants were found in the M_2 populations of all the mutagen treatments. The 'Tall' mutants were those in which the plant height ranged from 72.8 to 129.2 cm, where as the plant height, in the control plants, ranged from 50.7 to 60.9 cm.

Dwaf : The 'Dwarf' mutants had short plant length. Some of these mutants were unbranched. Those which are branched, had a more or less bushy appearance. The over all growth of these plants was stunted. Dwarf mutants were recorded in the M_2 populations of SA and EMS treated plants and not in gamma rays treated population.

Semi male sterile : In EMS treated M_2 population, some plants showed the pollen fertility ranging from 24.87 to 33.89%. Moreover, in control it ranged between 96.52 to 99.98%. These plants were categorised as semi-male sterile plants. These plants were recorded only in EMS M_2 population.

Early flowering : The plants in the mutagen treated populations which commenced flowering about 15-20 days earlier than control plants were categorised as Early flowering. In the control plants, flowering commenced on 40-50 days after germination, where as in the early flowering mutants, the flowering was found to start on 19th to 29th day after germination.

Late flowering : The 'Late flowering' mutants took 65 to 73 days to flower, after germination.

High yielding : The physical mutagen (gamma rays), as well as, both the chemical mutagens (SA and EMS) were found to induce high yielding mutants. These mutants had considerably high seed yield.

High photosynthetic rate : In M_2 population of gamma ray treatment, 48 plants with high photosynthetic activity were isolated. These plants showed the photosynthetic rate in the range of 10.58 to 14.70 $\mu molm^{-2}S^{-1}$. However the trait was stably inherited in 8 plants in M_3 generation.

In the present investigation, various viable morphological mutants showing a wide range of variabilities recorded in the M_2 and M_3 generations of the physical as well as chemical mutagen treated

Table 1. Effect of different mutagens on *Ocimum sanctum* L.

Sr. No.	Morphological characters (Mutants)	Control	Mutagen-Gamma rays			Mutagen-SA			Mutagen-EMS		
			200 Gy	400 Gy	600 Gy	0.001%	0.002%	0.003%	0.1%	0.2%	0.4%
1.	Large leaf (cm^2)	14.50-24.03	27	24.19	25	36.88	28.90	26.50	29.30	27.58	28.36
2.	Small leaf (cm^2)	14.50-24.03	13.8	13.8	11.7	14.20	14.9	11.9	11.7	13.2	14.14
3.	Unbranched (No.)	20	-	-	-	-	-	-	-	-	-
4.	Profused branching (No.)	10-20	28	22	29	22	30	22	27	22	26
5.	Tall (cm)	50.7-60.9	103	98	129	119	129.2	96.2	72.8	126.3	109.1
6.	Dwarf (cm)	60.9	38.2	33.9	23.9	30.2	24.8	28.0	42.8	24.2	28.9
7.	Semi-male sterile (%)	96.52-99.98	24.87	29.80	31.59	24.89	27.80	28.98	31.50	33.89	26.98
8.	Early flowering (days)	50	35	20	31	19	36	23	40	32	29
9.	Late flowering (days)	50	73	64	67	68	62	63	65	68	66
10.	High yielding (g)	0.597	0.898	0.826	0.982	0.876	0.956	0.801	0.827	0.899	0.976
11.	High photosynthetic rate ($\mu molm^{-2}S^{-1}$)	0.21	10.58	10.05	14.70	12.76	10.02	-	-	-	-

Gy - Gamma rays
SA - Sodium Azide
EMS - Ethyl methane sulphonate

populations (Table 1) . Induction of viable mutations by chemical mutagens has been reported in *Carum copticum*[3], linseed[4], *Brassica napus*[5] and *Lathyrus sativus*[6].

Various types of leaf mutants have been reported by many workers[7,8]. Unbranched types of mutants were earlier reported by Mouli & Patel[9]. Such changes have been attributed to the chromosomal aberrations[10]. Mutations affecting the plant height have also been induced in various species[11-14]. Early flowering mutants have been reported by Kumar & Dubey[8].

According to George and Nayar[15], earliness in flowering, may be due to the physiological changes caused by irradition. Different types of sterile mutations have been produced in several crops by chemical and physical mutagens[16,17]. Biswas and Biswas[18] detected two semi-sterile mutants in *Lathyrus sativus* after gamma irradiation. The high yielding mutants were also isolated in various crop plants[13,14,19].

In the present investigation, multiple mutations have been isolated. The presence of more than one mutation in a single plant was termed as 'Multiple mutations'[20]. Multiple mutations have been reported earlier in *Foeniculum vulgare*[21], *Solanum nigrum*[22]. and *Plantago ovata*[23]. The agents with higher mutagenic efficiency induce more multiple mutations, and such mutations may accumulate several desirable mutations within one plant[20].

In the present investigation, some isolated desirable mutations such as high yielding and early flowering can be exploited commercially after stabilization of the character. The mutants with high photosynthetic rate, can be expolited for purifying the contaminated atmospheric air.

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