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Reaction of Sesame (*Sesamum indicum* Linn.) Mutant Generations against Webworm, *Antigastra catalaunalis* Duponchel

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Abstract

Sesame (*Sesamum indicum* Linn.) (Pedaliaceae) is an important oilseed crop grown in many countries. Among the insect pests infesting sesame, the webworm, *Antigastra catalaunalis* Duponchel (Pyraustidae: Lepidoptera) is predominant throughout the crop period. For managing this insect, resistant sesame varieties with higher yield potential and better adaptability to varied locations are essentially needed. Keeping this in view and based on earlier work, three promising accessions *viz.,* IVTS-2001-7, KMR-102 and TMV-3 were selected. To enhance resistance and/or yield traits, these three accessions in comparison with a susceptible check SVPR 1 were subjected to mutagenesis using gamma rays as physical mutagen; Ethyl Methane Sulphonate (EMS) and Diethyl Sulphate (DES) as chemical mutants. The first and generation mutants were evaluated under field conditions at Methikudi village, Cuddalore district, Tamil Nadu, Southern India during May, 2012-September, 2014. Webworm infestation was evaluated based on leaf, flower and capsule damage. Among the first mutant (M_1) and second mutant (M_2) generations, plants of the accessions namely IVTS 2001-7 and TMV-3 were rated as resistant and plants of SVPR-1 were highly susceptible to *A. catalaunalis*.

Keywords

Sesamum, Mutants, *Antigastra*, Resistance

1. Introduction

Sesame (*Sesamum indicum* Linn.) (Pedaliaceae) is an important oilseed crop grown widely in India and other countries. In most of the countries including India, sesame is an underutilized crop of local importance, which warrants improved use and conservation.

In many countries, it is being cultivated under both rainfed and irrigated conditions. Among the sesame cultivating countries, though India ranks first in the production, the productivity is comparatively less (413 kg/ha). This shortfall in the productivity is attributed to the incidence of insect pests. Among the key insect pests, webworm, *Antigastra catalaunalis* (Duponchel) (Pyraustidae: Lepidoptera) is the most serious. It occurs regularly and infests the crop during seedling, flowering and maturity stages and causes up to 90% yield loss [1]. But the attack is more severe during dry seasons and after initiation of flowering. *A. catalaunalis* feeds on tender foliage by webbing the top leaves, bores into the pods and shoots [2]. Keeping in view the ecological, socio-economical repercussions of insecticide use, exploiting varietal resistance in sesame against the webworm will be a viable management strategy. Mostly crop improvement in sesame for such desirable attributes is being attempted through conventional breeding methods, by exploiting the natural variability available in the germplasm. However, for changing the plant type, if adequate variability is not available in the existing germplasm, under such circumstances, mutation breeding can be effectively employed as an alternative or supplemental source [3] to increase variability in morphological and physiological characters besides inducing new plant ideotypes. Mutation breeding is relatively a quicker method for crop improvement and it has an added advantage over hybridization since the basic genotype of a variety is slightly altered. Keeping this in view, three sesame accessions selected from earlier screening [4] were subjected to physical and chemical mutagenesis with an aim to develop high yielding and /or insect resistant mutants.

2. Materials and Methods

Three sesame accessions *viz.,* IVTS-2001-7, KMR-102 and TMV-3 found promising against webworm were selected and in this study, they were subjected to physical and chemical mutagenesis. The mutant generations were evaluated for insect resistance in terms of leaf, flower and capsule damage and also yield.

2.1. Mutagenesis

Physical mutagen namely gamma rays and chemical mutagens namely Ethyl Methane Sulphonate (EMS) and Diethyl Sulphate (DES) were employed for treating the seeds of the selected accessions. Before mutagenesis, the LD_{50} values for each mutagen were determined by recording the seed germination in various dosages. Hundred seeds were placed on moist germination paper, replicated twice, for estimating the germination percentage and seedling vigour. For each accession, 500 well filled seeds were irradiated with gamma rays at specified dose determined based on the LD_{50} value reported earlier for this crop. Gamma radiation of the seeds was done at Centre for Application of Radioisotopes & Radiation Technology (CARRT), Mangalore University, Mangalore, India. For chemical mutagenesis, seeds pre-soaked in distilled water were treated with EMS for three hours. For DES, the mutagenic solution was changed once in half-an-hour by adding freshly prepared solution, as the half-life of the chemical is one hour at 30˚C. Non-irradiated dry seeds and seeds pre-soaked in distilled water served as the control.

2.2. Generation Study

The seeds subjected to mutagenesis were sown in the field along with the untreated parents under randomized block design with necessary replications. For each mutant generation, 30 plants per replication were raised and evaluated.

2.3. Field Screening of Mutant Sesame Accessions for Resistance against *A. catalaunalis*

Field screening of sesame accessions was done at the Methikudi village, Cuddalore district, Tamil Nadu, Southern India (latitude 11.39˚N and longitude 79.71˚E), during May, 2012-September, 2014. The sesame accessions were sown on the ridges of two metre length with a spacing of 30 cm between rows and 30 cm between plants. Thirty plants per replication and three replications were maintained per accession. A known susceptible check namely SVPR-1 [5] was maintained along with the selected accessions. Two rows of the susceptible check were also maintained around the experimental field as infestor crop. Recommended agronomic practices were followed except plant protection measures. The per cent leaf, flower and capsule damage caused by *A. catalaunalis* was recorded respectively from 15, 30 and 50 DAS onwards till harvest at weekly interval by observing thirty plants selected randomly per replication and the mean percentage damage was computed.

2.4. Statistical Analyses

The data obtained from the field screening of selected sesame accessions were analysed as per the standard methods [6]. Percentage values were arcsine transformed before carrying out the analysis of variance (ANOVA).

3. Results

3.1. Leaf Damage

In M_1 generation, among the three accessions, the minimum leaf damage was observed in IVTS 2001-7 in DES mutation followed by DES induced mutants of TMV-3 (**Figure 1**). In the M_2 generation, plants of IVTS 2001-7 recorded the least leaf damage in DES mutagenesis followed by gamma radiation (**Table 1**). In both the generations, parents and mutants of the susceptible check, SVPR-1 recorded the highest leaf damage.

3.2. Flower Damage

In M1 generation, the lowest flower damage was observed in plants of IVTS 2001-7 mutagenized with EMS (**Figure 2**), whereas in the M_2 generation, DES induced mutants perform better (**Table 2**). The maximum flower damage was recorded in both the generations of SVPR-1 mutagenized with DES.

3.3. Capsule Damage

Regarding capsule damage, EMS induced mutants of TMV-3 registered the minimum capsule damage in the first generation. The maximum capsule damage was noticed in DES induced mutants of SVPR-1 (**Figure 3**). With regard to the M_2 generation, EMS induced mutants of IVTS 2001-7 were found promising (**Table 3**).

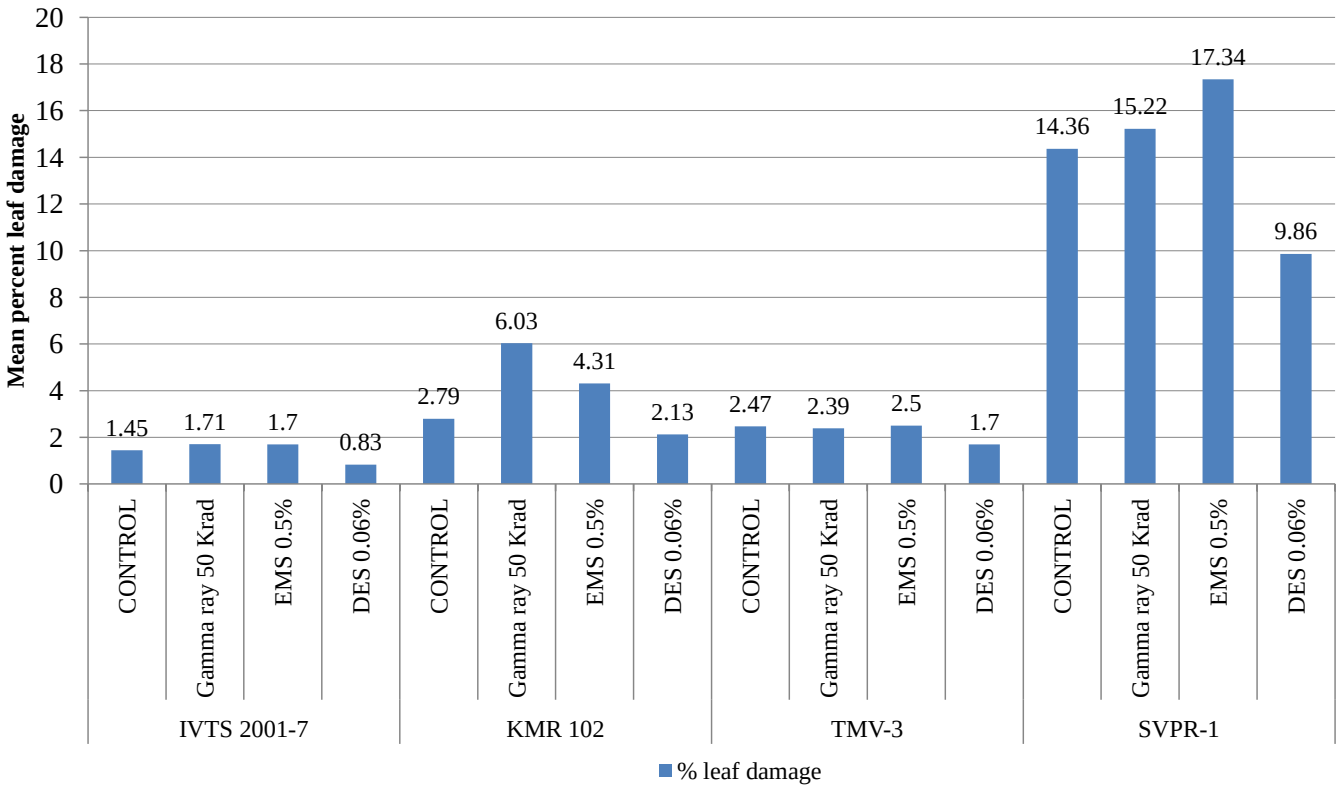

Figure 1. Resistance evaluation of the selected sesame accessions to *A. catalaunalis* based on leaf damage in M1 generation.

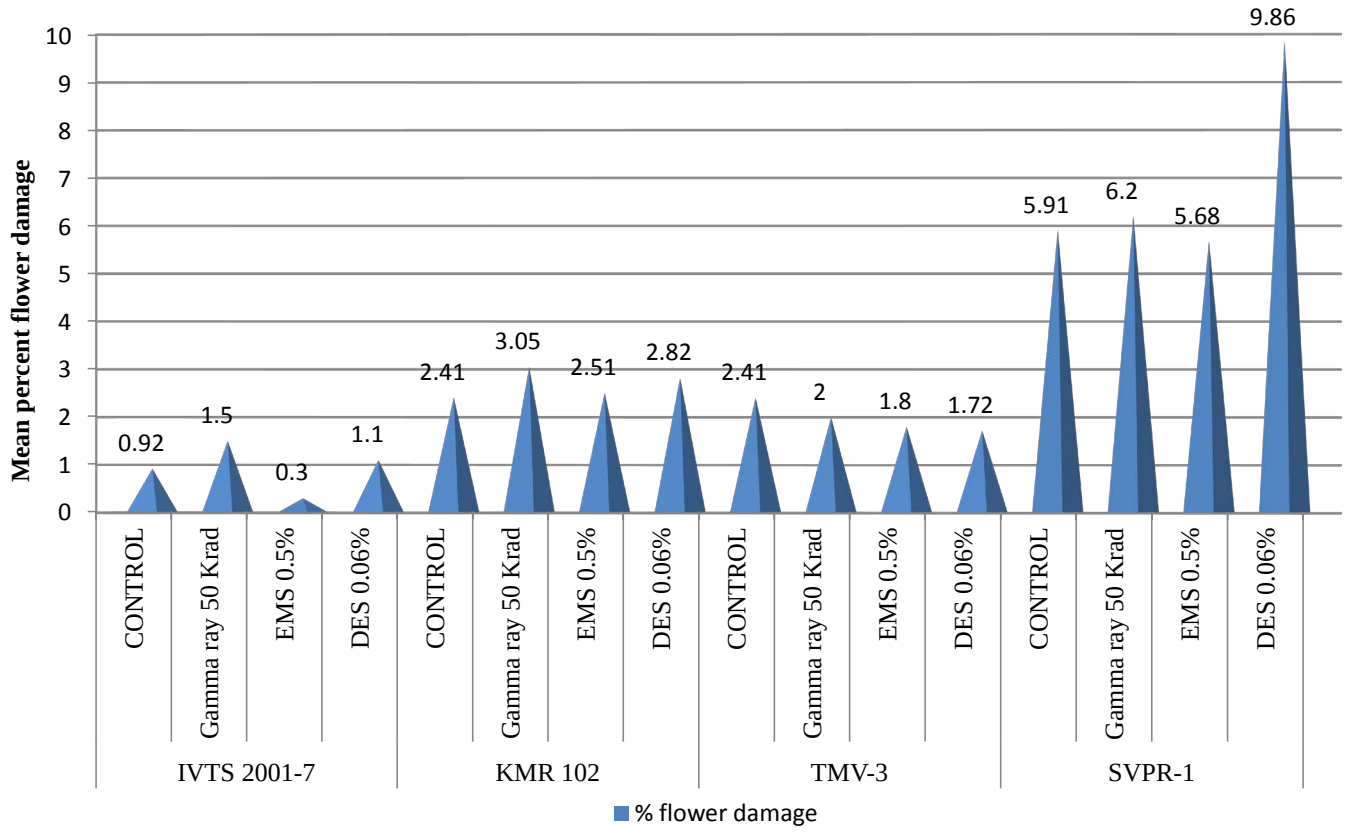

Figure 2. Resistance evaluation of the selected sesame accessions to *A. catalaunalis* based on flower damage in M1 generation.

Table 1. Effect of mutagens on resistance in sesame against *A. catalaunalis* based on leaf damage in M_2 generation.

Genotypes	Control		Gamma ray 50 Krad		EMS 0.5%		DES 0.06%	
	% leaf damage	CV	% leaf damage	CV	% leaf damage	CV	% leaf damage	CV
IVTS 2001-7	1.90 ± 0.11 (7.92 ± 0.05)	2.46 (1.21)	1.40 ± 0.02 (6.80 ± 0.04)	3.13 (1.25)	1.90 ± 0.12 (7.92 ± 0.09)	4.18 (2.10)	1.31 ± 0.06 (6.60 ± 0.18)	9.08 (4.76)
KMR 102	4.91 ± 0.05 (12.80 ± 0.17)	4.12 (2.42)	6.41 ± 0.16 (14.69 ± 0.04)	4.21 (2.14)	5.30 ± 0.02 (13.31 ± 0.09)	2.05 (1.17)	4.69 ± 0.08 (12.51 ± 0.11)	2.88 (1.57)
TMV-3	2.63 ± 0.11 (9.32 ± 0.13)	4.84 (2.56)	2.09 ± 0.04 (8.33 ± 0.04)	3.05 (1.67)	3.33 ± 0.06 (10.51 ± 0.20)	5.71 (3.29)	3.70 ± 0.02 (11.09 ± 0.05)	1.39 (0.78)
SVPR-1	12.89 ± 0.28 (21.04 ± 0.32)	4.98 (2.65)	13.11 ± 0.27 (21.24 ± 0.04)	3.65 (1.91)	18.68 ± 0.16 (25.62 ± 0.03)	1.75 (0.49)	10.87 ± 0.35 (25.63 ± 0.11)	3.62 (1.92)
S. Ed.	0.05		0.07		0.06		0.08	
C. D. (p = 0.05)	0.10		0.14		0.12		0.18	

Each value is a mean of three replications @ thirty plants/replication; Values in parentheses are arc sine transformed values.

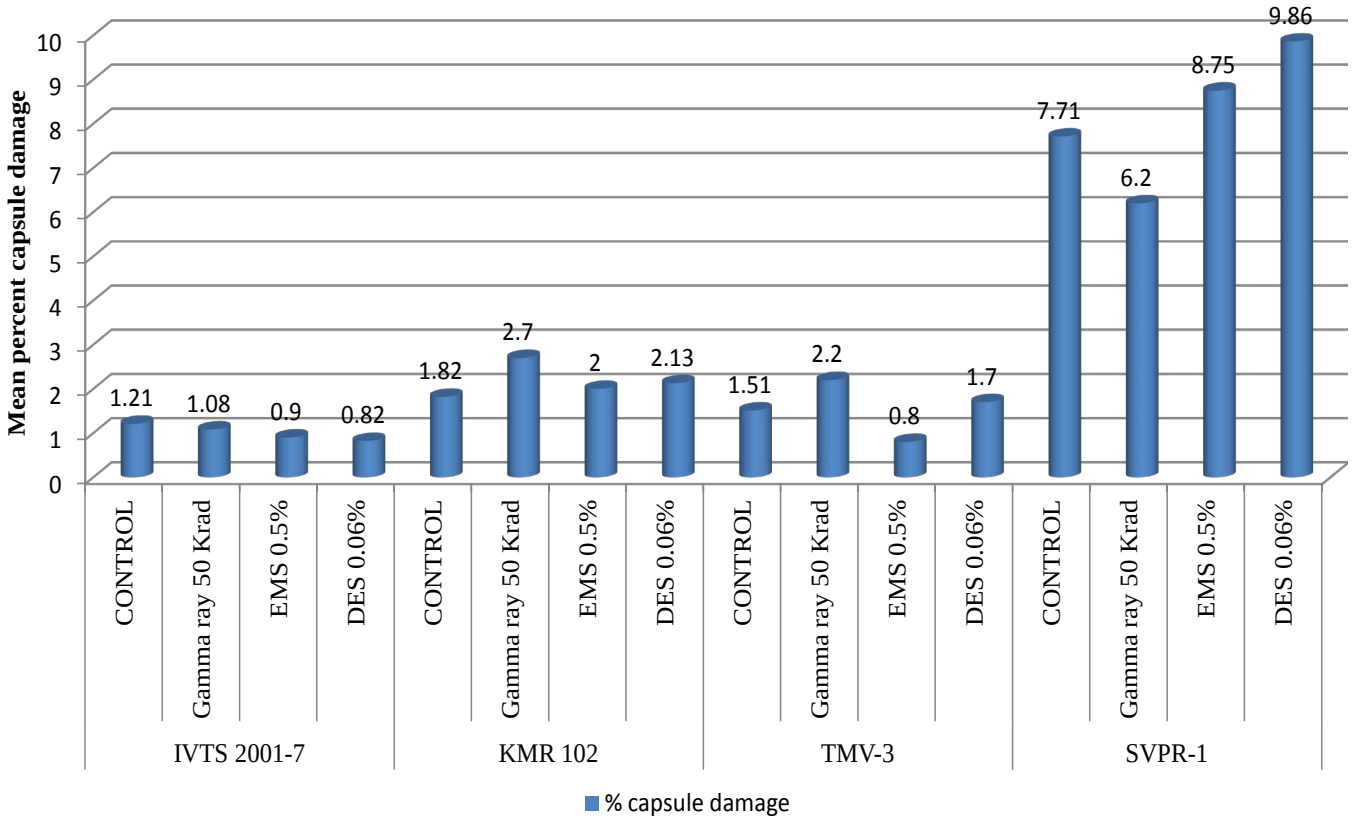

Figure 3. Resistance evaluation of the selected sesame accessions to *A. catalaunalis* based on capsule damage in M1 generation.

Table 2. Effect of mutagens on resistance in sesame against *A. catalaunalis* based on flower damage in M_2 generation.

Genotypes	Control		Gamma ray 50 Krad		EMS 0.5%		DES 0.06%	
	% flower damage	CV	% flower damage	CV	% flower damage	CV	% flower damage	CV
IVTS 2001-7	1.40 ± 0.04 (6.80 ± 0.05)	2.12 (1.16)	1.80 ± 0.02 (7.72 ± 0.05)	1.91 (1.01)	2.01 ± 0.04 (8.14 ± 0.06)	7.10 (3.85)	0.07 ± 0.05 (4.76 ± 0.20)	14.17 (7.15)
KMR 102	3.12 ± 0.07 (10.19 ± 0.10)	2.83 (1.70)	2.82 ± 0.04 (9.81 ± 0.06)	2.09 (1.03)	2.71 ± 0.07 (9.46 ± 0.10)	2.94 (1.88)	4.41 ± 0.08 (12.12 ± 0.11)	2.99 (1.63)
TMV-3	1.90 ± 0.05 (7.93 ± 0.07)	3.30 (1.68)	0.79 ± 0.03 (5.10 ± 0.10)	6.56 (3.32)	1.50 ± 0.04 (7.05 ± 0.09)	4.66 (2.45)	1.55 ± 0.05 (7.19 ± 0.10)	5.61 (2.60)
SVPR-1	11.20 ± 0.14 (19.56 ± 0.09)	1.36 (0.75)	9.60 ± 0.02 (18.05 ± 0.03)	0.44 (0.25)	7.33 ± 0.16 (15.70 ± 0.06)	2.48 (1.25)	6.40 ± 0.09 (14.65 ± 0.11)	2.30 (1.32)
S. Ed.	0.04		0.09		0.08		0.07	
C. D. (p = 0.05)	0.08		0.20		0.18		0.15	

Each value is a mean of three replications @ thirty plants/replication; Values in parentheses are arc sine transformed values.

Table 3. Effect of mutagens on resistance in sesame against *A. catalaunalis* based on capsule damage in M_2 generation.

Genotypes	Control		Gamma ray 50 Krad		EMS 0.5%		DES 0.06%	
	% capsule damage	CV	% capsule damage	CV	% capsule damage	CV	% capsule damage	CV
IVTS 2001-7	1.71 0.05 (7.51 ± 0.96)	(2.65 (1.16)	1.01 ± 0.06 (5.81 ± 0.17)	4.2 (2.45)	0.70 ± 0.04 (5.72 ± 0.20)	26..34 (3.06)	1.31 ± 0.03 (5.66 ± 0.04)	14.17 (7.14)
KMR 102	3.32 ± 0.03 (10.49 ± 0.20)	7.85 (4.21)	1.80 ± 0.05 (7.71 ± 0.12)	11.23 (5.94)	2.39 ± 0.03 (8.89 ± 0.15)	5.88 (3.05)	4.69 ± 0.06 (7.71 ± 0.04)	4.01 (2.33)
TMV-3	1.80 ± 2.04 (7.72 ± 0.04)	2.48 (1.68)	1.30 ± 0.02 (6.55 ± 0.05)	6.00 (2.95)	1.00 ± 0.06 (5.72 ± 0.20)	36.04 (13.66)	3.70 ± 0.05 (7.92 ± 0.04)	5.61 (2.60)
SVPR-1	6.87 ± 0.05 (15.18 ± 0.11)	1.45 (0.75)	7.31 ± 0.05 (6.59 ± 0.05)	4.52 (2.18)	8.01± 0.05 (16.45 ± 0.04)	3.23 (1.70)	16.87 ± 0.05 (17.92 ± 0.04)	2.30 (1.32)
S. Ed.	0.05		0.03		0.09		0.07	
C. D. (p = 0.05)	0.10		0.06		0.18		0.15	

Each value is a mean of three replications @ thirty plants/replication; Values in parentheses are arc sine transformed values.

4. Discussion

Among the two mutagenesis methods, chemical mutants performed better than the physical mutants. Among the mutant generations, DES induced mutants of IVTS 2001-7 showed the minimum leaf damage in both the generations. Flower damage was the least in EMS induced mutants of IVTS 2001-7 in the M_1 generation, while in the M_2 generation, DES induced mutants were better. In contrast to the above, capsule damage was the least in EMS induced mutants of TMV-3 in the M_1 and M_2 generations. This trend clearly indicates the segregation of the traits. Webworm resistance traits were found promising in the mutants of IVTS 2001-7 and TMV-3. But mutant plants of KMR-102 registered the maximum yield. In some of the mutants plants of KMR-102,

desirable yield enhancing characters such as tripodding in a single node were observed, as reported earlier [7]. Sesame lines with multi-capsules per leaf axil were considered as ideal plant type in breeding for high-yielding varieties [8]. In addition to that, another mutant character namely pink colour corolla was observed in M_2 generation. Similarly, flower colour pigment was recorded in gamma rays mutagenised plants [9].

Hence it is concluded that mutant plants of IVTS 2001-7 and TMV-3 may be evaluated and exploited in the further generations for insect resistant traits while mutants of KMR-102 may be used as yield contributing donor in future breeding programme.

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