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Article : Relative response of Methyl Methanesulphonate (MMS) on growth and yield parameters in Lentil (Lens culinaris Medik.) var. K-75 & L-4076.

Author : Alka Khan and Samiullah Khan[Aligarh Muslim University, Aligarh]

ABSTRACT:

The effect of mutagenesis was studied in lentil varieties K-75 and L-4076. Seeds of lentil varieties K-75 and L-4076 were subjected to 0.01%, 0.02%, 0.03% and 0.04% of methyl methanesulphonate (MMS).The mutagenic treatments of methyl methanesulphonate caused biological damage which was measured by M_1parameters. Data on various quantitative traits such as plant height, days to flowering, days to maturity, plant height, fertile branches/plant, pods/plant, no. of seeds/pods, 100 seeds weight (g) and total plant yield (g) were also recorded in both varieties of lentil. The mutants were morphologically quite distinct, as compared to the control and to each other. The mean values of plant height, fertile branches/plant and pods/plants were found to be significant in both varieties and no. of seed/pods were found to be significant in both varieties. No. of seeds/pods and 100 seeds weight did not show any significant difference. The total plant yield did not show significant in var. K-75 but it is significant in var. L-4076.

INTRODUCTION:

Pulses have formed an integrated part of Indian farming system and have played an important role in human diet. Lentil is a nutritious food legume. It is cultivated for its seed and mostly eaten as dhal. Lentil has relatively higher contents of protein, carbohydrates and calories compared to other legumes and is the most desired crop because of its high average protein content and fast cooking characteristic in many lentil producing regions (Muehlbauer *et al.*, 1985). Seeds can be fried and seasoned for consumption, flour is used to make soups and mixed with cereals to make bread and cakes, (Williams and Singh, 1988). Protein concentration of lentils reportedly range from 22-34.6% and 100 g of dried seeds contain 340-346 gm calories, 12% moisture, 0.6 g fat, 65.0 g total carbohydrate, about 4 g fibre, 2.1 g ash, 68 mg Ca, 325 mg P, 7.0 mg Fe, 29 mg Na, 780 mg K,

0.46 mg thiamine, 0.33 mg riboflavin, 1.3 mg niacin (Adsule *etal*., 1989; Muehlbauer *etal*., 1985). Among the cool season legume crops, lentil is the richest in the important amino acids (lysine, arginine, leucine and sulphur containing amino acids) (Williams *etal*., 1994). The starch content ranges from 35-53% in the seed and 42% in dry matter while amylase varies from 20.7 to 38.5% of the seed starch (Huisman and Vanderpoel, 1944). **.**

Induced mutagenesis may be of special use in broadening the genetic variability of quantitatively inherited characters. The mutagenic treatments induced mutations affecting plant height, growth habit, branching and stem structure, leaf morphology, inflorescence, calyx, flower, pod, fertility and seed colour have been reported in lentil (Sinha *et al*., 1987; Tyagi and Gupta, 1991; Ashutosh and Dubey, 1992; Vandana *et al*., 1994; Ramesh and Dhananjay, 1996; Tyagi and Ramesh, 1998; Solanki and Sharma, 1999; Jeena and Singh, 2000). Therefore, planned mutagenesis can create more variability and with efficient selection procedure, it is possible to get a desirable shift in the mean values of the characters under consideration. Against this background, the aim of present study is to study the biological damage and spectrum of induced variability and the shift in means for quantitative traits as compared to the control in M_1 generation.

KEYWORDS: Chemical mutagen, MMS, Mutagenesis, *Lens culinaris*.

Materials and Methods:

Two varieties of lentil (*Lens culinaris* Medik) namely, K-75 and L-4076 were used in the present study. Seeds of both the varieties K-75 and L-4076 were obtained from Genetic Division of Indian Agriculture Research Institute, New Delhi. Certified, healthy seeds of var. K-75 & L-4076 were presoaked in distilled water for 9 h and then treated with methyl methanesulphonate (MMS) with four different doses prepared in sodium phosphate buffer at 7.0 pH for 6 h with constant intermittent shaking. The treated seeds were washed in running tap water for 30 minutes to remove the residual effect of the mutagen sticking to the seed coat. One set of seeds was kept untreated to act as control for comparison. Seeds were sown in the earthen pots of 30 cms diameter. Seedling survival was calculated on 30^{th} day after sowing in pots while, the plant survival was calculated at maturity after transplantation of seedlings in field. As soon as, the 5th leaf stage emerged out, the seedlings were space transplanted in the field at a distance of 90 cm apart in Complete Randomized Block Design (CRBD) with 2 replicates in each dose and control to observe the seed germination, mature plant height, pollen fertility and plant survival in M_1 generation.

Result:

Germination growth (Table 1)

The two varieties of lentil differed in their response to mutagenic treatments with regard to germination recorded 10 days after sowing. Treatment with 0.04% MMS had more toxic effect on both the varieties of lentil (K-75 and L-4076). In both the varieties the percentage of seed germination was reduced in gradually with increasing the mutagenic doses.

Plant survival at maturity and lethality percentage (Table 1)

Mutagenic treatments of MMS showed differing effects on the plant survival in the two varieties. In both the variety, lowest the percentage of plant survival at maturity was found at 0.01% of MMS treatments. The higest percentage of plant survival was found in control in both varieties. At higest dose of mutagen (0.04% MMS), the Percentage of plant survival at maturity was 71.00% in var. K-75 and 63.00% in var. L-4076. The lethality was found higest in both varieties at 0.01% of MMS treatments.

Pollen fertility and sterility (Table 1)

The pollen fertility was higest in 0.01% of MMS treatments in both the varieties and the lowest percentage of pollen fertility was found in 0.04% of MMS treatment in both the varieties. A progressive increase in EMS doses was found with an increase in pollen sterility in both varieties.The higest pollen sterility was 17.23% and 20.36% at 0.04% MMS treatment in the both the varieties K-75 and L-4076 respectively.

Days to flowering (Table 2)

As in the days to flowering, most of the mutagenic treatments increased the days to flowering in both the varieties.

Days to maturity (Table 2)

Most treatments of mutagen brought about a significant decrease in days to maturity in the two varieties of lentil.

Plant height (Table 2)

Significant difference in plant height was recorded in var. K-75 for all mutagenic treatments. But no significance was found in plant height of var. L-4076 of lentil.

Fertile branches/plant (Table 2)

Most treatments of MMS brought about a significant increase in fertile branches/plant in both varieties.

Pods/plant (Table 2)

Significant difference in pods/plant was recorded in all the mutagenic treatments of MMS in both varieties.

No. of seeds/pod and 100-seeds weight (g) (Table 2)

No significant difference in no. of seeds/pod and 100-seeds weight (g) was recorded in both the varieties of lentil.

Total plant yield (g) (Table 2)

No significant difference in total plant yield was recorded in var. K-75. But all the treatments of MMS brought about significant difference in total plant yield in var. L-4076.

Discussion:

These two varieties of lentil differed in response to mutagenic treatments regarding germination, plant survival at maturity and pollen fertility. This type of response was also recorded regarding days to flowering, days to maturity, plant height, fertile branches/plant, pods/plant, no. of seeds/pod, 100-seeds weight (g) and total plant yield (g).

The means in respect of germination, survival and pollen fertility reduced after methyl methanesulphonate (MMS) treatment. In the present study, reduction in seed germination was dose dependent and linear. Similar observations were made in *Vigna radiata* (Khan and Ali, 1987; Khan *etal*., 1998 a,b; Khan and Wani, 2004, 2005; Parveen, 2006). Inhibition in seed germination after irradiation has been attributed to changes in biochemical and physiological system (Sparrow and Woodwel, 1962). Decrease in germination was attributed to inhibitory effect of

mutagen (Sahai, 1974). Plant survival at maturity, in both the varieties, decreased over the control and it was dose dependent. These results are contrary to the earlier findings of Raghuvanshi and Singh (1979) in chilli, Anwar and Reddy (1981) in rice, Khan and Ali (1987) in mungbean and Mehrajuddin (2001) in chickpea. Sterile pollen observed in both the control as well as in the mutagenic population of both the varieties of lentil used in the present study. However, the percentage sterility increased considerably in mutagen treatments. A depression in pollen fertility was also reported in*Vigna radiata* (Khan and Hashim, 1978; Ganguli and Bhaduri, 1980; Khan and Siddiqui, 1992; Wani, 2007) and *Lens culinaris* (Sinha and Godward, 1972; Reddy and Annadurai, 1991; Wani and Khan, 2003).

Two lentil varieties differed in response to the mutagenic treatments regarding quantitative traits viz., plant height, days to flowering, days to maturity, number of fertile branches, number of pods, seeds per pod, 100 seed weight (g) and total plant yield (g). Generally, reduced plant height, days to flowering, days to maturity, seeds per pods and 100 seed weight (g) were recorded in both the varieties. Similar finding have been reported earlier in mutagenic treatments in various crops (Nerkar, 1970; Sinha and Godward, 1972; Dixit and Dubey, 1981, 1986, 1987; Dixit 1985; Sharma and Sharma, 1979, 1980, 1986; Sinha and Chaudhary, 1987; Kalia and Gupta, 1989; Khan *etal*.,1994; Khan and Wani, 2004; Wani and Khan, 2007). Reduction in mean number of days to flowering in some of the mutagenic treatments indicates the possibility of isolating early maturing type in later generations. Kaul (1980) suggested that mutation of two dominant gene to their recessive forms makes for an early flowering in peas. The shift in mean and the nature of induce variability and their relationship with increased concentrations of mutagens indicate differential mutagenic sensitivity between the two lentil varieties. Borojevic (1970) reported that the genetic differences even though very small (as single gene difference) can induce significant changes in the mutagen sensitivity which influence various plant characters in M_1 generation. Present study confirms the reports of some of the earlier workers that bold seeded types are more sensitive to mutagens than the small seeded types (Sinha and Godward, 1972; Sharma and Sharma, 1986; Kalia and Gupta, 1988).

Most of the vital mutants recovered in the present study have also been recovered in earlier studies (Sharma and Sharma 1977a, b, c, 1978, 1980, 1981; Dixit and Dubey 1983a, b, 1984). Some of the mutants induced in the present study such as (eg. Early maturing, fertile branches/plant, pods/plant and total plant yield) showed desirable characters for breeding and hold promise for isolating improved types from their progenies in later generations.

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