CHAPTER - 7
DISCUSSION

Marathwada region of Maharashtra state grows cotton on around 7 lakh hectares with average productivity of 110 kg lint/hectare. It is being grown under rainfed conditions and considered as a cash crop. It plays vital role in elevating socio economical status of farmers community.

After 1970, tetraploid cotton (varieties and hybrids) dominated and replaced gradually diploid cotton species, popularly known as Desi cotton. However it is now being grown under neglected conditions for one or other reasons despite having genetic superiority over tetraploid cotton for drought resistance to sucking pests besides higher yield potential, ginning outturn and maturity coefficient. In comparison with tetraploid cotton species, it has poor fibre properties and there by poor count. Genetic improvement work is on going and resulted in evolving long linted genotypes. However, very little bit attention is being paid to evolve a genotype having simultaneous improvement for major and minor properties related with count. Genetic variation existing with available material is also limited and breeders rarely take into account all fibre characters. Variability can be created with adopting conventional breeding approach, but to break the negative linkages, create new combinations, chances of getting success with conventional breeding approach are remote and limited. Keeping these views in mind, an attempt in present investigation has been made to adopt mutation breeding.
Never the less to get the desired results and to use appropriate mutagene with appropriate dose, information required is not available, with reference to diploid cotton. In present investigation, the study was undertaken to evaluate vis-a-vis efficacy of various mutagene (physical and chemical) besides to create new kind of genetic variability.

Mutagenic effectiveness in fact, is a measure of the frequency of mutations induced by unit dose of a mutagene. While mutagenic efficiency give an idea of the proportion of mutation in relation to other associated undesirable biological effects such as gross chromosomal abberations, lethality and sterility induced by the mutagene in question. Efficiency of the mutagene in present investigation is measured by adopting the parameters like mean, genetic variance, range of variability, parameters like genotypic correlation, recombination, stability and minimum regression towards original population also have been considered for first time to measure efficacy of mutagene.

In present investigation, the efficiency of the four mutagens (3 physical and one chemical mutagene) has been evaluated by using following parameters

1) Ability to generate additive type of variability (high mean with higher genetic advance).

2) Capability to express minimum regression effect.

3) Ability to generate materials with higher mean coupled average or below average stability bi equal to unity (average stability) and bi with higher than unity (below) average stability.
4) Ability to raise intensity of desirable association and to break undesirable association.

5) Extent of recombination (%)

Results are discussed in relation with above parameters.

.1 EFFICACY OF MUTAGENE IN Generating ADDITIVE TYPE OF VARIABILITY IN POPULATION.

.1.1 Mean Fibre Length (MFL) :-

The primary aim of any breeder is to create genetic variability in the population for further improvement. However, genetic variability of only additive nature is useful in development of variety. Kind of variability existing in the segregating population is realised by estimating genetic advance and mean performance. Higher mean and higher magnitude of heritability associated with higher estimate for genetic advance indicate the presence of additive nature of variability and offer scope for further improvement. When there is a loss of genetic gain in the population, it indicates presence of tight linkage and complete dominance and hence offer relatively less scope for further improvement.

In present investigation, efficacy and effectiveness of four mutagene have been evaluated considering magnitude of additive variance. Data presented in table 3 revealed relatively higher population mean for mean fibre length, fibre fineness, maturity coefficient and fibre bundle strength over control. Amongst the four mutagene,
population mean of 0.2% EMS and 20 KR was at par with each other and significantly superior over 30KR and 15KR by margin of 4.1% and 2.8% respectively. 0.2% EMS mutagene maintained its ranking position even in M3, M4 and M5 generation, while sudden jump in M5 for MFL (Mean Fibre Length) was evident in 20KR population. Considering higher mean and a linear relationship over generations, 02% EMS appeared to be more effective than 20KR for this traits.

In respect of fineness, chances of getting fine fibre is remote with 20KR, While it was more with 0.2% EMS. This is evident as mean population over generations was 4.1 (ug/inch.) in 0.2% EMS as against 4.42, 4.48 and 4.35 (ug/inch) in 30KR, 20KR and 15KR respectively. 0.2% EMS proved its efficacy over rest of the treatments not only for MFL (Mean Fibre Length) and fibre fineness, but also with negatively related character, like fibre bundle strength at "0" gauge.

The population mean for fibre strength in 0.2% EMS was 49.4 as against 48.6 in 15KR, 48.2 in 20KR and 49.2 in 30KR.

In respect of Mc (Maturity Coefficient), however 0.2% EMS did not prove relatively less effective compared with 20KR followed by 30KR.

When all these four characters, which play important role in deciding count ability of a genotype are taken into consideration, three characters viz. MFL (Mean Fibre Length), fibre fineness and fibre bundle strength are remarkably elevated in treatment 0.2% EMS.
1.1.2 Genetic Advance:

In respect of genetic advance, 15 KR had 16.1% in M2 generation and decreased to the extent of 15.8% at the end of M5 generation. A drastic reduction in population for 30KR was evident as it was only 3.7% in M5 as against 12.4% in early generation. Population 20KR did not show such ups and downs over generations. It was very meager and ranged in between 3.6% to 7.3% though mutagene 20KR expressed population mean at par with 0.2% EMS and significantly superior over 15KR and 30KR. Magnitude of genetic advance was megre through out the generations. Higher mean with less genetic advance offer limited scope for selection. This probably is an indication that the presence of dominance type of gene action and tight linkages exist with 15 KR & 30 KR mutagene. 0.2% EMS in all generations recorded, the higher mean coupled with higher genetic advance except M5, emphasises that there is still scope and effective selection may lead to development of still longer fibres.

Trend observed in present investigation lead to conclude that additive type of variability with substantially higher magnitude can be achieved by exposing materials to 0.2% EMS rather than exposing to gamma-rays of 15KR, 20KR and 30KR.

1.2. Fibre Fineness:

1.2.1 Mean Performance:

In respect of fibre fineness, population mean over generations was 4.3 in 15KR 4.5 in 20KR. 4.4 in 30KR and 4.1 in 0.2% EMS.
Vis-a-vis comparison of four mutagens for efficacy, results indicated slightly impact of 15KR and 20KR. Fibre fineness in M2 was 4.4 (15KR) and 4.7 (20KR) and it reached to the level of 4.2 and 4.3 in M5 generation. Thus, negative shifting resulted in decreasing fibre fineness value to the extent of 6.6% and 9.3% respectively in 15KR and 20KR population. No such regression behavior was evident in 30KR and 0.2% EMS treated population. It was 4.62 mean value in M5 as against 4.85 in 30KR and 4.27 in M5 as against 4.3 in EMS. Taking into account the magnitude of regression phenomenon, 15KR and 20KR have relatively less practical utility as compared to 30KR and 0.2% EMS. Gama-ray dose induces higher biological effect than other. Through relative biological effectiveness (RBE) of other is higher. Moreover, primary damage with higher doses induced by ionizing radiation is modified in enzymatic repair process and only a small fraction of damage remains to be realized in biological change. In present investigation, extent of abnormality induced by 30 KR was of higher magnitude in early M1, M2 generation and subsequently might be repair due to which 30 KR treatment proved more effective. Moreover, overall population mean of 0.2% EMS was 4.1 and showed an edge over 30KR by margin of 7.3%. Considering the mean performance, 0.2% EMS as a chemical mutagenic appeared to be more effective over rest of the mutagens in recording higher population mean with practically no regression effect.
1.2.2 Genetic Advance:

In respect of genetic advance, 15KR recorded consistently higher magnitude in M3, M4 and M5. However, a drastic sudden fall in M5 was evident. It was 18% in M5 against 31% in M2. Mutagene 20KR generated population having dominance of dominant gene action and can be supported with its poor magnitude throughout the generations. In 30KR, genetic advance was the highest in M2 generation over rest of the populations but showed a declining trend and had only 6% genetic advance at the end of M5 generation. In population of 20KR and 30KR, chances for further genetic improvement are remote. Chemical mutagene 0.2%EMS, for genetic advance though not the highest in each generation, it ranked mostly second in order of merit and maintained its position from M2 to M5 generations. This is evident as estimate for genetic advance was 26% to 25% respectively from M2 to M5. The present level for fibre fineness in 0.2% EMS was quite superior over rest of the treatments and due to presence of substantial genetic advance in the population, there is still scope for further improvement. In fact, Asiatic cotton are well known for their coarse nature, 0.2%EMS provided opportunity to bring Asiatic cotton to the level of Egyptian cotton:

These results lead to conclude that different mutagens had differential capacity to shift the mean. The present investigation also enlightened that the same character can be shifted to the negative direction depending on kind of the mutagene used and the genetic back ground of the control
population. Borogevic (1968) pointed out that increase of the mean, as observed in the present investigation for MFL and fineness, was not only result of artificial or natural selection but also a result of the genetic nature of individual species. In present investigation change in the genetic nature has been induced by 20KR and by 0.2% EMS in different directions. Physical mutagenic (20KR) resulted in developing materials with dominant nature with tight linkages while 0.2%EMS treated population created variability of additive nature. The study also showed that mean value for these two characters viz. MFL (Mean Fibre Length) & Fineness in M5 for 15KR and 20KR approximating the M2 value. This phenomenon has been called as "Spontaneous Recovery" effect. Behaviour of M5 approaching to the level of controlled population depends on mutation frequency and magnitude of change, number of genes involved and type of gene and type of treatment involved. The superiority of 0.2% EMS over the rest of the mutagens was observed in the present investigation.

1.3 Bundle strength :-

1.3.1 Mean Performance :-

Fibre strength of asiatic cotton is quite superior over upland cotton. Higher fibre strength of asiatic cotton species may be attributed towards higher coarseness and shorter fibre length. Such higher values of fibre strength have relatively less contribution in elevating count potential of a genotype. A genotype is said to be desirable only when it has higher fibre strength with increased or
optimum mean fibre length and fineness. In present investigation with the above specific objective, materials were screened and advanced. Results of the present investigation reaveled quite reverse trend, with the trend observed for MFL (Mean fibre length) and fibre fineness. A substantial genetic improvement for fibre strength can be achieved if materials are exposed to 0.2% EMS and 30KR rather than to 15 KR and 20 KR. This is evident as the overall population mean over generation was 49.2 g/tex as against 48.2 and 48.6 in 20 KR and 15 KR. In comparison with control population mean in 15KR and 20KR did not show regression behaviour. It was matchable with control mean. In population treated with 30KR and 0.2% EMS, similar trend was noted with slight an edge over mean of control,15KR and 20KR.

1.3.2 Genetic Advance :-

In all the four generations a linear relation for genetic advance between magnitude and generation, was evident. However, in 0.2% EMS and 30KR population, it was in descending order, while in 15KR and 20KR in ascending order. These results suggest that different mutagens behave in different direction. From the study of apparent linear relationship observed in the present investigation, it can be inferred that variation is mainly due to gene or point mutation rather than chromosomal deformities. Similar views were also expressed by Mullar (1954) in cotton.

A perusal of Table 3 revealed that low and middle order doses gave relatively more variance than the higher dose which suggest that whatever the variation occurred for
this character were in uni-directional. Increased magnitude of G.A. (Genetic advance) in 15KR and 20KR over remaining two treatments suggests that the frequency of micro mutations are more. Magnitude of G.A. (Genetic advance) in all generations was inconsistent with dosage. Decreasing order was observed in 30KR and 0.2% EMS while reverse trend was evident for 15KR and 20KR mutagene. Considering mean and G.A. (Genetic advance) simultaneously, which indicate the extent of magnitude of additive variability, 15KR and 20KR appeared to be more effective though it had slightly decreased mean population for fibre strength. A significant improvement in population of 15KR and 20KR may be possible as it had 20.4% and 34.6% G.A. (Genetic advance) respectively. Regression behavior for fibre strength was not evident with all four mutagens, whereas it showed regression phenomenon for MFL (Mean Fibre Length). Effect of the mutagens for these two characters was quite reverse and can be attributed to genetic background of control population. Strain NA 39 was mainly evolved and selection pressure was applied from F2 to F6 only for fibre length thereby showing little bit improvement for fibre length in present investigation. No attention for fibre strength was given during the course of selection. Thus, genetic background of NA-39 resulted in getting minimum improvement for fibre length while remarkable for fibre strength. Similar results were also reported by Shroff (1983), Fotiads and Miller (1973).
From the results so far presented on the basis of mean and magnitude of G.A. (Genetic advance), it can be inferred that 15KR and 20KR appeared to be more effective because it recorded higher magnitude of G.A. (Genetic advance), mean matchable with other population and higher than control, besides higher magnitude of heritability and genetic coefficient of variation.

1.3.1 Components i.e. To, T1, T2 of fibre strength :-

Studies on fibre strength character is estimated by using "0" gauge Bundle Strength. This method does not take into account the weak places in the fibre from which the fibres are generally broken. Hence, spacer 1/8 inch (3.2mm) width is inserted in between the clamps by which test specimen length will be increased to 15mm. Hence use of the (3.2 mm) spacer, accounts for weak points in the fibres come in to play and fibre bundle break of at lower breaking strength. At the time of break of fibre it elongates, which can be observed on callibrated scale. Considering the fibre slippage, the observed value should be multiplied by 0.8. Similar observations are taken by using 2 such spacers making total specimen width (11.8 + 6.4) = 18.2mm. and breaking strength will be lesser as compared to "1/8"guage, test specimen sample.

1.3.1.1. Mean Performance :-

An attempt in present investigation has been made by conducting an elaborate study on three aspects of fibre strength that are To, T1 and T2. It was also intended to
understand little more about the direction of the effect of the mutagene on these three minute but important component related with fibre strength. Treatment wise mean, range and estimates of variability parameters of M5 generation are depicted in Table 17.

A scrutiny of the data presented in Table 17 showed 49.6 g/tex value for T0, 28.8 for T1 and 20.6 for T2, irrespective of the treatment population, mean in M5 for T0 was 51.5, for T1 28.4 and for T2 21.5. Mutagene with 15KR dose could not improve T0 above the control, while remaining three treatments surpass control by margin of 3.2%, 4.4% and 3.4% respectively. Superiority of 30KR mutagene in enhancing TO over rest of the treatments was evident.

The trend in respect of T1 and T2 was coinciding with T0, Lowest mean for T1 and T2 was recorded by 15KR while it was highest and statistically significant over population mean, control as well as mean of 20KR and 30KR. Middle order dose of 20KR and 0.2% EMS were matchable with each other for these two traits. Considering mean as a criteria and taking into account all the three parameters simultaneously, 30KR treatment appeared to be more efficient.

1.3.1.2 Genetic Advance :-

When genetic advance as a parameter has been used for evaluating the efficacy of four mutagens, results were not in favour of 0.2% E.M.S. and 15KR. Treatment 20KR had appreciable magnitude of genetic advance for all the three characters. Treatment 30KR was nearer to 20KR. Treatment 0.2% EMS, however, did not prove its efficacy in
generating higher genetic advance for all the three parameters. It was only 55%, 11.6% and 2.4% for T0, T1 and T2 respectively with poor mean as against 21.1%, 10.0% and 11.3% in 30KR and 45.7% 13% and 20.7% for 20KR.

In summarising the results in fibre strength, results indicated the ineffectiveness of low dose (15KR) and 0.2% EMS. Between 20KR and 30KR, treatment 20KR seems to be more useful in inducing mutations in desired direction for those three minute characters. Estimate of G.A (Genetic Advance) was of higher magnitude for all these three characters and offers scope still for further improvement.

1.3.2 Eo & E1 (Elongation at '1/8' & '1/4') Characters :-

1.3.2.1 Mean Performance :-

Vis-a-vis efficacy of four mutagens was also studied for E1 and E2 (elongation at "1/8" and 1/4 inch guage) characters. These are the two characters related with fibre maturity and fineness.

A perusal of the Table 14 revealed relatively less efficacy of 20KR and 15KR due to significantly less mean values over control by margin of 10.5% and 13.8% respectively. Treatment 30KR followed by 0.2% EMS recorded highest population mean for E1 and E2. None of the mutagens proved effective in checking regression phenomenon. This is evident as population mean of each treatment was either significantly or numerically less over control and expressed shift in negative direction for both the characters. The trend observed for E1 character was in direction of higher
dose with higher mean. Taking into account all these aspects, effective improvement seems to be possible, provided materials are exposed to the 30KR population.

1.3.2.2 Genetic Advance :-

It is interesting to note that the treatment 15KR, recorded significantly less mean for E1 and E2 characters, though ranked first in generating highest magnitude with additive type of variability. Estimates for genetic advance for these two characters depicted in Table 14 indicated 13.4% and 27% Genetic advance respectively for E1 and E2 (elongation at 1/8 & 1/4 inch gauge length) characters. Magnitude of genetic advance decreased with increasing dose.

When mean and genetic advance are considered separately, no perfect trend was evident but different treatments behaved differently. When both the parameters are taken into account and by sacrificing little bit mean 30KR treatment indicated relatively higher efficiency over rest of the treatments. The present low level of E1 and E2 can be improved not only over mean of three mutagenes but also over control by applying selectiln pressure in population.

1.4 Maturity Coefficient (Mc)

1.4.1. Mean performance :-

Treatment wise and generation wise analysis of variance for Maturity Coefficient (Mc) character is given in Table 14 indicated significant treatment differences within and amongst treatments. Pooled analysis generation wise and over all pooled analysis also indicated significant differences.
On pooled basis, percentage of mature fibres was highest with 20KR which was at par with 30KR and significantly superior over mean of 15KR and EMS. Between 15KR and EMS, they were statistically at par. However, narrow differences amongst mean of four treatments was evident. These results lead to conclude that the mutagenic treatments showed regression behavior in 15KR and 20KR. This is evident as drastic reduction at the end of M5 generation was observed inw15KR and 20KR when compared with values of M2 generation. In the present investigation because of narrow differences, it was not possible to compare efficacy of four mutagens.

1.4.2 Genetic Advance :-

Studies on G.A (Genetic advance) revealed relatively higher efficacy of 0.2% EMS over rest of the treatment. It ranked first in recording highest genetic advance in M2, M3, M4 and M5 generations. To get the genotype with less immature fibre and to create substantial genetic variability for further improvement, exposing material to EMS will be worth as compared to rest of the treatments.

1.5 Economical Characters :-

Behavior of derivatives of four mutagens in comparison with control were evaluated for four important economical characters viz. Ginning Outturn (GOT), Boll weight (B.W.), Seed Index (S.I.) and yield. An attempt also has been made to study vis-a-vis efficacy of four mutagens. Data pertaining to analysis of variance, mean, range and variability parameters like Phenotypic Coefficient of
Variation (PCV), Genetic Coefficient of Variation (GCV), Heritability and Genetic Advance are presented in Table 14. In evaluating efficacy of four mutagens, criteria of the magnitude of additive variance which is estimated on basis of Genetic Advance and mean has been considered. Results of the present investigation are discussed in this context.

1.5.1 Seed Index (SI) and Ginning Outturn (GOT) :-

1.5.1.1 Mean Performance :-

A perusal of Table 17 revealed that untreated population had seed index value of 6.8 and genetic potential of Ginning Outturn (GOT) was 33% irrespective of treatment, the population mean for these two characters approaching control. This is evident as Ginning Outturn (GOT) and seed Index values were 33.2% and 6.5 respectively. Both of these characters expressed fast regression towards original population.

Among the four treatments, marginal differences for both the characters were existing and most of them were statistically non-significant when pooled variance considered.

However, population mean is 15KR and 20KR established superiority, though numerically, over 30KR and 0.2% EMS in respect of seed Index. Population of each mutagene regressed below control, It was lowest in 20KR followed by 15KR and 0.2% EMS. However, these results are contradictory with the results reported by Al-Didi (1985) and Fotiadis & Mille (1973) who pointed out shifting of mean in negative direction for Ginning Outturn (GOT) even in M1, M2, and M3 generation. Shroff (1983) who reported a significant
improvement in Ginning Outturn (GOT) and Seed Index (SI). Atazhov (1965) reported non-effectiveness of mutagens in genetical improvement of Ginning Outturn (GOT) and Seed Index (SI). It may be attributed to low dose of mutagens and unable to stimulate the character. Ata Zanov (1965) in cotton, Sharma and Boyes (1962) in wheat also reported non-effectiveness of irradiation in stimulating the character. Scossiroli (1989), Borovjevic (1988) in cotton reported regressed mean, over population mean and attributed it to absence of selection pressure due to which mean approaching towards original population. Gregory (1986) in finding out the causes for regression behavior presented data which suggest that number of negative and positive mutation in the polygene system were nearly equal and that it was in the magnitude of phenotypic effect in the mutation which gives negative effect and not uni-directionality. He also showed that the number of such changes become large if their magnitudes become small. Bathman (1959) disagreed with above hypothesis and concluded that the alternation of mean is variable and could be explained by assuming all mutations to be in one direction. Seed tolerance to Gamma-rays increases with moisture content to certain limit, beyond which additional moisture content causes a decrease in tolerance. Several reports also available indicating iteration between moisture and temperature for mutation induction.
1.5.1.2 Genetic Advance :-

Estimates for Genetic Advance (G.A.) for ginning out
turn was maximum in 20KR (7.4%) while it was lowest with
30KR (3.9%). In respect of seed Index, highest genetic
variance and therefore genetic advance was evident in
0.2% EMS while it was lowest with 20KR. Considering the
magnitude of Genetic Advance (G.A), which offer substantial
scope for further improvement, 20KR for Ginning Outturn
(GOT) and 0.2%EMS for seed Index are worth to mention.
0.2%EMS population for Ginning Outturn (GOT) also recorded
appreciable magnitude of genetic advance. Taking into
account all these aspect, seed size can be improved
effectively by exposing material to 0.2% EMS with little bit
improvement for Ginning Outturn (GOT). Ginning Outturn
(GOT) character with maintaining optimum seed size can be
achieved provided materials subjected to 20KR exposure.

1.5.2 Boll weight and Seed cotton yield.

1.5.2.1 Mean Performance :-

Differences due to treatments for boll weight and seed
cotton yield in 15KR, 30KR and 0.2% EMS were significant
indicating effectiveness of mutagenes in creating
substantial genetic variability. A look at Table 17
indicated population mean of 364 gms and in 30KR was
followed by 380 gms in 20KR, 399 gms in 15 KR and highest of
446 gms in 0.2% EMS. In comparison with control, population
mean of 15KR, 20KR and EMS was significantly superior by
margin of 8%, 3% and 21%, respectively. Population mean of
30KR, however, shifted in negative direction and also
regressed to the extent which was below control. Relatively lower efficacy of 30KR treatment observed in present investigation can be attributed towards it's detrimental effect leading to more injury, more percentage of lethality and sterility.

Amongst the three physical mutagens, a declining trend was evident with increasing the dose of g-rays. Similar results were also reported by Atazanov (1965) which strongly supports to the findings of the present investigation.

1.5.2.2 Genetic Advance (GA): -

Relatively higher efficacy over rest of the treatments of 0.2% EMS can be attributed towards creating substantial magnitude of genetic advance (G.A) which was to the tune of 23% as against 9.4% in 30KR and 13.8% in 20KR. Effectiveness of 15KR treatment can not also be ignored as it recorded highest magnitude of genetic advance (G.A) coupled with mean which was second in order of merit. Higher mean coupled with higher genetic advance (G.A) indicating a substantial scope of further improvement which can be obtained by using EMS and 15KR treatment. In respect of boll wt. unirradiated population had boll weight of 1.9 gm which was significantly less over 20KR numerically less over 15KR, 30KR and 0.2% EMS. Magnitude of genetic advance (G.A) in comparison with other characters though was negative & negative, however it was lowest in 15KR and 0.2% EMS as compared to 20KR and 30KR. Considering genetic advance (G.A) and mean expressed by four mutagens it will be worth while to give more attention to 20KR over other mutagens.
2 CAPABILITY OF MUTAGENE TO CHECK REGRESSION PHENOMENON :-

Mutation breeding in comparison with conventional breeding methods has certain limitations. It is mainly used for horticulture crops which are multiplied by vegetative propagation and hence no impact of regression phenomena. Though contribution has been also reported in seeded crop, one cannot ignore the "regression tendency" a peculiar characteristics of mutation breeding. Regression tendency may be described as tendency of the muted population to approach to original with advancing generation. The time required to approach to original population and extent of regression is dependent on the type of mutagene used and effectiveness of selection.

The regression ability can be studied by comparing the population mean of advanced generation with the control as well as ascertaining proportion of genotypes showing at par or significantly negative performance over control population. Using these three parameters i.e., (1) Regression of mean of irradiated population in comparision with mean of control. (2) Percentage of derivatives having non significant effect (3) Percentage of genotypes showing significant negative performance vis-vis of mutagen were observed in the present investigation.

2.1

In present investigation, derivatives of 15KR, 20KR and 30KR and 0.2%EMS were advanced up to M5 generation and were evaluated in large scale trial in M5 generation by assessing their performance for 14 characters. Results
presented in Table 15 revealed a mean of 23mm mean fibre length for control population. The population mean irrespective of treatment was 23.8mm. Results enlightened about the non-effectiveness of mutagens in expressing minimum or no regression tendency. This is evident as population mean in M5 was 23.8, 23.8, 23.5, and 23.9(mm) as against 23 (mm) of check. Absence of regression effect may be attributed towards the effect of selection pressure applied in every generation.

Percentage of genotypes showing non significant performance over population mean as well as percentage of genotypes showing significant negative performance are also used for evaluating the efficacy of four mutagens. Results revealed that 72% genotypes of 0.2% EMS which though recorded highest population mean had mean fibre length (MFL) a-par with control while 9% genotypes had significantly less mean fibre length (MFL). These results lead to indicate that most of the genotypes of 0.2%EMS approached nearer to control while 9% genotypes shifted in negative direction. On the contrary, 15 KR generated material with least regression effect as only 42% derivatives of this group approached nearer to control. Likewise, only 9% genotypes of 0.2% EMS had mean fibre length (MFL) significantly less over control. The treatments which shared minimum percentage for these two parameters are being considered as effective in checking regression habit. From this point of view, 15KR and 0.2% EMS appeared to be more effective over rest of the treatments.
2.2

In respect of fiber fineness, the trend was quite reverse to that observed with mean fibre length (MFL). All the mutagenes except 0.2% EMS had mean which was shifted even below control, while it was at par in 0.2% EMS. This is evident as population mean for fibre fineness was 4.7, 4.8, 4.7, and 4.1 respectively in 15KR, 20KR, 30KR and 0.2% EMS as against 4.1 of control. Number of derivatives having performance at par with control was maximum in 20KR (23%) and 30KR (19%) and was followed by 15KR (17%) and 0.2% EMS (14%). 0.2% EMS did not prove its efficacy in generating maximum number of lines which had performance significantly higher than population mean. It was only 36% in 0.2%EMS followed by (43%) in 15KR.

When all the three parameters are taken into account simultaneously, 20KR and 30KR were ineffective in checking regression effect while 0.2% EMS satisfies all the three criterias and hence considered as more effective.

Data pertaining to maturity coefficient (Mc) depicted in Table 14 & 15 revealed profound effect of mutagene and their efficacy in shifting population mean either in the positive or negative direction. Negative performance indicates regression effect. Regression effect in 0.2%EMS and 30KR was maximum when compared with control. It was shifted in negative direction to the tune of 4.2% and 9.8%. On the contrary, population mean of 20KR though not regressed over control, it was approached towards original (population) value. Among the four mutagenes, 15KR had good potential not only in checking regression effect but showed a superiority over control by margin of 7.1%.
2.3

Percentage of genotypes having non-significant performance with control was highest Viz. (73%) in 0.2%EMS followed by 20KR with (28%). It was minimum in 30KR and 15KR. Significantly less performance for Maturity coefficient (Mc) over control was ranged between 9% (0.2% EMS) to 57% (15KR). These results suggest that 15KR followed by 30KR had least ability to check regression effect while effective checking can be achieved by adopting 0.2%EMS followed by 20KR. Considering all the three parameters simultaneously, 15KR appeared to be more effective for improving Maturity Coefficient (Mc).

2.4

A detailed study was conducted for fiber tenacity character. It was measured by adopting three gauge lengths, T0, T1 and T2. Analysis of variance treatment wise and pooled is presented in Table 13. Results indicated non-significant mean with 15KR for T0, T1 and T2 when compared with control value. These results suggested that the population mean of 15KR though does not show regression over control, it is approaching control value. No such regression behavior was evident in rest of the populations. Population mean of derivatives evolved by exposing to 20KR, 30KR and 0.2% EMS was significantly higher and ranged between 3.2% to 4.4% in T0, from 5.5% to 8.9% in T1 and from 4.3% to 6.7% in T2. It is surprising to note that lower dose i.e. 15KR had detrimental effect while higher dose i.e. 30KR had effect in positive direction. Physical mutagene
30KR had population mean significantly higher over control and was to the tune of 4.4%, 8.9% and 6.7% respectively for T0, T1 and T2. Minimum regression effect was noted with 30KR for these three characters and hence considered as relatively more effective over rest of the mutagenes.

Proportion of genotypes generated by each mutagene having performance at par with control and genotypes expressing performance significantly less over control were also used as criteria for evaluating efficacy and effectiveness of mutagenes. In all 9, 19, 38 and 8 genotypes of 15KR, 20KR, 30KR and 0.2%EMS were also scrutinised for these two criterias. Results revealed relatively higher efficacy of 30KR for T0, 15KR for T1 and 20KR for T2 as these respective mutagenes yielded minimum no. of lines having mean performance matchable with control. This is evident as only 34%, 42% and 23% genotypes had performance at par with check. Mutagene 15KR from this point of view appeared to be ineffective for the reason of generating maximum number of genotypes matchable with control.

Data were also scrutinised for genotypes expressing performance significantly less over control. Mutagene 30KR for T0, 15KR for T1 and 20KR for T2 were undesirable as maximum number of genotypes of those mutagenes expressed character in the negative direction. On the contrary, treatment 15KR for T2 and treatment 20KR for T0 and T1 are with minimum number of genotypes having significantly less performance over control. When all the three parameters are
taken into account, 30KR followed by 20KR, are worthy to mention in generating materials in desired direction (Table 18, 8 & 19), 0.2% EMS did not prove it's effect for all the three parameters and three characters.

2.5

Character elongation at "1/8" gauge (E1) and "1/4" gauge (E2) also played vital role in deciding fiber tenacity and, there by in determining count potential. Population mean of each treatment, % of genotypes at par with control and % of genotypes significantly less over control are presented in Table 21. Results indicated relatively higher efficacy of 0.2%EMS and less of 20KR for E1. Similar trend was also observed for E2. Mutagene 20KR in order of merit ranked lowest can be attributed towards showing maximum regression tendency. Population mean of all the four mutagenes had regression effect and were significantly less over control for both the characters. However extent of regression was maximum which was to the tune of 10.5% for E1 and 13.8% for E2 in 20KR. Regression effect in 0.2% EMS was also evident but comparatively of less magnitude over rest of the treatments. From these results, it may be inferred that 20KR dose with the same genetic background ground of NA-39, if used, chances of getting genetic improvement for E1 and E2 (Elongation at 1/8 & 1/4 gauge length) and there by, fiber strength will be more. Moreover, chances of getting minimum number of genotypes having significantly regressed value over control was more in 0.2% EMS. This is evident as only 27% of the
total genotypes for E1 and E2 expressed values significantly less over control, while with 15KR it was maximum and to the extent of 36% for both the characters.

2.6

In present investigation, an attempt also has been made to understand the impact of four mutagens on toughness and stiffness characters. The study was also intended to compare vis-a-vis efficacy of four mutagens by using parameters like extent of percent of genotypes at par with mean and percent of genotypes significantly less over the control. (Table 20). Results indicated opposite trend for Toughness and stiffness characters. Treatment wise population mean as well as over all population mean was either significantly or numerically less over control while in stiffness, no regression effect was evident. Regarding toughness and stiffness, 30KR treatment had an edge over rest of the mutagens in expressing minimum regression effect. These mutagens and the derivatives generated by these treatment did not show regression impact. This is evident as population mean of 30KR was 77.4% for stiffness and 5.6% for stiffness as against 75.9% and 4.7% of control. Percentage increase over control was to the tune of 1.9% (Toughness) and 19% (stiffness) over control in 30KR treatment. Highest magnitude of regression effect was noted in 15KR for toughness and in 0.2% EMS for stiffness. Likewise, ability to generate genotypes with performance stastically at par with control was least in 15KR for Toughness (28%w and stiffness (14%). Rest of the treatments generated materials above 30% of the total genotypes with
values matchable with control. On application of third criteria i.e., extent of genotypes having significantly less performance over control, it was maximum in 15KR for both the characters, 0.2%EMS generated only 27% of the total genotypes which expressed stiffness and toughness significantly less over control. Taking into consideration all the three parameters simultaneously, 30KR followed by 0.2% EMS are worthy to mention over rest of the treatments.

2.7

Analysis of variance for seed index and ginning outturn (GOT), depicted in Table 14 revealed significant "F" value. However, in pooled analysis, population mean of four mutagenes were non significant amongst each other. Treatment differences within each treatment was evident. Regression effect for ginning outturn (GOT) and seed index was evident in all four mutagenes. Magnitude of regression was ranged from -2.9% to -5.8% for seed index while population mean of all the groups approached to original. The trend in all the four treatments for ginning outturn (GOT) was same and population mean ranged between 32.9% to 33.4% as against 33% ginning outturn (GOT) of control. Narrow differences amongst four groups and also in comparison with control, observed in present investigation may be attributed to seed of control variety i.e., NA-39 which has relatively larger seed size.

Gustafsson (1942), pointed that larger seeded varieties of plant species, in general, would suffer less from radiation than small seeded ones by virtue of the
former being left with relatively more number of unaffected cells following mutagenic treatment. Non response, observed in the present investigation for seed index and related character may be attributed towards bold seed size of control population. More over, studies on range of variability indicated wider range i.e., 32% to 35% for 15KR 31.8% to 36.7% for 20KR, 38.8% to 35.5% for 30KR and 31.7% to 35.3% for 0.2% EMS. These parameters indicated effectiveness of mutagenes in development of genotypes with extreme performance in positive and negative direction for ginning outturn (GOT) and seed Index. Scrutiny of data and grouping of genotypes in significant, positive and significant negative, revealed maximum frequency of non-significant genotypes for both the characters. It ranged from 28% to 51% for ginning outturn (GOT) and from 57% to 86% for seed Index. As a result though variation amongst the genotypes created effectively by mutagenes, their population mean due to higher frequency of non-significant genotypes approached to the origin. In respect of efficacy of four mutagenes in preventing the regression effect, data revealed relatively higher efficacy of 15KR and 20KR for ginning outturn (GOT) and of 30KR & 15KR for seed Index. Extent of regression was -2.9% for seed Index while it was 1.2% for ginning outturn (GOT) in respective treatments. Highest regression to the tune of 5.8% for seed Index and 0.3% for ginning outturn (GOT) in 20KR and 30KR for respective characters was evident on the basis of regression magnitude. Treatment 15KR appeared to be more
useful as it expressed least regression effect. Likewise, genotypes with significant negative performance was recorded in 15KR for both the characters there by, supporting higher efficacy of 15KR mutagene over rest of the mutagenes.

2.8

Calculated "F" value for boll weight indicated significant differences amongst genotypes of 50KR. In respect of seed cotton, treatment difference within each group and amongst four groups was evident. Magnitude regression for boll weight in 15KR, 30KR & 0.2% EMS was not negative but practically approached the original population mean. Mutagene with 20KR dose had population mean of 2.3gm as against 1.9gm of control, showing superiority by margin of 20%. Most of the genotypes, irrespective of mutagene, indicated performance at par with control. No improvement for boll size under rainfed condition in desi cotton was also reported by Ansingkar (1983). Least response for boll size was also reported by Bhurwaj & Chuturvedi (1980) and Kadapa (1973). This may be due to mutagenic treatments increase the range of variability for most of the polygenic traits compared to the control. In present investigation, polygenic traits like seed cotton yield also showed wider range of variability as compared to other qualitative characters and results are in line of Shroff (1977). Relatively higher efficacy of chemical mutagene 0.2% EMS as observed in the present investigation was also reported in Bandnwar.1 variety of G. hirsutum by Shroff. (1977)
Regarding seed cotton yield, control population had 390gms potential while 15KR, 0.2% EMS showed an edge over control by recording higher mean by margin of 2.3% to 14%. Population mean of 20KR and 30KR regression over control was to the tune of 2.5% and 6.6%. Least tendency was shown by 0.2% EMS derivatives followed by 15KR for regression ability and hence considered as more useful than other for improvement of the characters.

Percentage of genotypes having non-significant seed cotton yield was least in 0.2% EMS followed by 15KR. Likewise, percentage of genotypes with significant negative performance was ranged between 27% to 37%. Considering three parameters i.e., population mean, genotypes with non-significant performance, genotypes with significant negative performance, 0.2% EMS is on the merit followed by 15KR.

From the results so far presented, it can be concluded that 0.2% EMS appeared to be effective in reducing magnitude of regression effect for mean fibre length (MFL), fineness E1, E2 (elongation) and seed cotton yield. Treatment 30KR was worth adopting for T0 T1 and T2, (Bundle strength at 0, 1/8, 1/4 gauge length) seed Index, toughness and stiffness characters, because of no regression or least regression in 0.2% EMS over rest of the mutagens. For characters like mean fibre length, fineness, E1, E2, (elongation at 1/8, 1/4 gauge), maturity coefficient (Mc), seed Index, seed cotton yield, Toughness and stiffness, utility of 0.2% E.M.S. is more. In creating additive kind of
variability, use of either 0.2% EMS or 20KR will be appropriate as either 0.2% EMS or 20KR ranked first or second in order of merit.

The successful performance of mutant line depends on beneficial mutation. The genotypes of which agronomic attributes such as adaptability, quality and yield superior are to be selected. In general, biological damage and mutation frequency increase with irradiation dose. Hence it is suggest to comprmise between desired mutation frequency and degree of biological damage and shold be in tolerance. 0.2% EMS from above point meets the requirement.

When all these four parameters and fourteen characters are taken simultaneously into consideration, 0.2% EMS a chemical mutagene, can be suggested to the breeders for its use in crop improvement programme. This is because 0.2% EMS proved effective in creating high mean with additive type of variability for 7 out of 14 characters, less magnitude of regression effect for (5 out of 14) characters. Minimum number of genotypes at par with control for (3 out of 14) characters as well as least number of genotypes with significant negative performance for 10 out of 14 characters were noted in 0.2% EMS.

In general, physical irradiation is most effective in producing mutations due to its penetrating power into vegetative tissue. However, Upadhya & Purohit (1973) reported better mutations with chemical mutagens, and support strongly to result of present investigation. Relatively higher efficacy of chemical mutagen can be attributed towards nature of inducing more point mutation rather than chromosomnal breakage.
Efficacy of mutagene in evolving genotypes with higher mean coupled with average stability and below average stability. These results are in agreement with the results of Upadhyya & Purohit (1973).

3 STABILITY PARAMETERS:

In present investigation an attempt has been made to evaluate derivatives of four mutagenes by adopting Ebberhert and Russef Mean, bi, and 32 di for four important characters viz. mean fibre length (MFL), fineness, maturity coefficient (Mc) and fibre strength were presented in Table 7 & 8. Stability parameters were worked out only for four characters as it was intended to understand the impact of mutagene on fibre properties. They were worked out using data generated over M2, M3, and M4 generations.

In a cotton, mean significantly higher over population mean with average stability has more relevance because these genotypes under varied conditions may express stable performance. Breeders are also interested in evolving genotypes with higher mean responsive to environment. Such genotypes with change in the environment may perform better than the present level. Effectiveness of mutagenes was evaluated on the basis of two parameters i.e., higher mean with average stability (bi=1) and higher mean with below average stability (bi>1). Results regarding efficacy of four mutagenes are discussed in light of above two criteria.

The present investigation was intended to understand the impact of mutagene on stability parameters. Genotypes having higher mean viz. with non-significant bi are
preferred as they may express stable performance under vagaries of environment. Cotton crop always shows more impact of GXE rather than genotype or environment. Several instances have been reported indicating expression of genotype with a shorter fiber length, reduced count though it was evolved as long staple. Hence, average stability in cotton crop has relevance. Evolving a genotype with average stability depends on the type of breeding method employed.

3.1

In present investigation, efficacy of four mutagenes have been evaluated by studying their potential to yield, with average stability. Data presented in Table 7 & 8 revealed relatively higher efficacy of 20KR mutagene followed by 0.2% EMS. Physical mutagene 20KR yielded 63% of the total genotype with non-significant regression value (bi=1). In case of 0.2% EMS percentage of such genotypes was 62%. These genotypes had mean fibre length (MFL) either at par with check or significantly higher over check. In case of 15KR, the percentage of genotypes having wider adaptability was to the extent of 55%, 0.2% EMS did not prove its efficacy in evolving genotypes with higher frequency which will show consistent performance over environments. Like-wise, mutagene 15KR and 20KR induced variations which are yielding ability of genotypes to express stable performance. This is evident as 55% and 52% of the total genotypes of 15KR and 20KR respectively had non significant regression coefficient value with fineness, either at par or significantly higher over untreated population.
Percentage of genotypes having average stability to the extent of 22%, 31%, 28% and 31% for 15KR, 20KR 30KR and 0.2% EMS respectively for maturity coefficient (Mc) character. Using criteria of average stability, recommendation of 15KR will be uneconomical followed by 30KR. These results also enlighten that neither lower dose nor higher dose of physical mutagene has ability to generate materials with stable performance. Considering magnitude of genotypes with stable performance 0.2% EMS followed by 20KR has an edge over others.

3.2 Fibre Bundle Strength :-

In respect of fiber strength, percentage of genotypes having regression coefficient value equal to unity was ranged in between 83% to 100% (0.2% EMS). It is striking to note that all the lines of 0.2% EMS treated had average stability coupled with bundle strength significantly higher over control. On the contrary, physical mutagene 20KR though gave 93% of the total genotype with non-significant bi, some of them had fiber strength significantly higher over control.

Considering all the four characters simultaneously, 20KR expressed effect in desired direction. This mutagene gave 68%, 52%, 31% and 93% of the total genotypes having average stability with mean numerically or significantly higher over control for mean fibre length (MFL), maturity coefficient (Mc), fineness & bundle strength. While evaluating efficacy of three breeding methods viz. straight cross, back cross and multiple cross, Ansingkar (1983) also
reported higher efficacy of straight cross method in generating maximum number of lines with average stability. These results also indicated a relation of breeding method with stability, besides genetic back ground. 20 KR dose of gamma-rays is advocated to get maximum number of genotypes of average stability combined with performance either numerically or significantly higher over control. The second best in order of merit is 0.2% EMS.

3.3 Efficacy of mutagenes in relation with below average stability :-

3.3.1 Mean Fibre Length (MFL) :-

Higher mean coupled with bi significantly higher than unity indicate higher ability of a genotype to respond to favourable environment. On the contrary, above average stability i.e., bi significantly less than unity indicates inability of a genotype to respond to the environment. Below average stability, therefore, has been used as a yard stick to measure vis-a-vis efficacy of four mutagenes in the present investigation. Use of such parameter in evaluating efficacy of mutagen was so far rarely adopted.

A perusal of Table-10 indicated that physical mutagen with 20KR dose developed 42% strains of below average stability (bi > 1.0) with mean significantly higher over control for mean fibre length (MFL) and fineness. On the contrary, 15KR for mean fibre length (MFL) and 0.2% EMS for fineness had hardly 33% and 25% genotypes with below average stability respectively. These results suggest that the desirable combination of strains having below average
stability for both the characters combines with longer length and fine fiber may be possible in greater frequency provided mutagene with 20KR dose is adopted. Chemical mutagene 0.2% EMS, even though recorded mean fibre length (MFL) and fineness significantly higher over population mean, it showed relatively less effectiveness in developing strains of below average stability (bi > 1.0). Ansingkar and Bhale in (1983) diploid cotton also obtained higher proportions of genotypes of below average stability by multiple cross method over straight cross and back-cross methods. These results also suggest that "responsiveness to the environmental" is under genetic control and may be improved and further elevated by adopting proper breeding methodology. In present investigation, amongst four mutagenes, 20KR proved its merit over rest of the mutagenes for both the characters.

3.3.2 Maturity coefficient & fibre bundle strength :-

In respect of maturity coefficient (Mc), 55%, derivatives of 15KR recorded regression coefficient value significantly higher than unity combined with significantly higher mean over control. No such encouraging and higher efficacy was noted with rest of the treatments.

Regarding fibre strength, all the four mutagenes did not prove efficient in yielding genotypes with below average stability. It was only to the tune of 11%, 5%, and 8% in 15KR, 20KR and 30KR respectively. Moreover, 0.2% EMS totally failed as none of the strains from this group had shown ability to respond to the environment (bi => 1.0)
Considering all the four parameters simultaneously, 20KR dose of physical mutagen seems to be more effective over rest of the treatments as it gave higher frequency of genotypes with below average stability for mean fibre length (MFL) (42%), fineness (42%), and substantial for maturity coefficient (Mc) (21%) and a bundle strength (15%). Chances of evolving the genotypes having below average stability with combination for mean fibre length (MFL), fineness (significantly higher over population mean) and maturity coefficient (Mc), fibre bundle tenacity (at par with control) are more with 20KR dose.

Mutation breeding aims at long staple, high tenacity and maturity with better uniformity and elongation. Obtained variety should be early maturing and resistant to pests-disease with high yield potential and ginning outturn. Fibre properties should be suitable for chemical finishing to import easy care characteristics and blending with synthetic fibres. It may not be so difficult to have genotype with all desirable characteristics. Use of 15 KR dose may help in achieving the goal. Failure of other doses and 0.2% EMS probably due to induction of double stranded breaks by a one-hit event i.e. double strand breaks are formed in subsequent number of low doses. Review of literature indicate that different types of chemical changes are induced by ionizing radiations whereas, ultra violet induces only few changes in DNA, a major pyrimidine dimer.

While summarising the discussion on screening of genotypes performing well in favourable and unfavourable
conditions, it may be concluded that three genotypes from 30KR for mean fibre length (MFL) recorded regression coefficient value significantly higher than unity (below average stability) with mean significantly higher over control. Ability to respond to the environment can be seen from fig (1) which indicated that line No.47, 41, and 36 may express mean fibre length (MFL) in the range of 19 to 21 mm and as the environment improves. These genotypes evolved by adopting 30KR dose have ability to express upto 28 mm. These genotypes have inherent ability to express maximum under favourable conditions and may surpass not only desi cotton check but also to *G. hirsutum* check NHH-44. Control population of NA.39 did not show any improvement with change in the condition as evident from its performance of 21 mm under unfavourable and 23 mm under favourable conditions. These results also enlightened that only 30KR has effectiveness in generating genotypes with below average stability. In respect of fineness, two derivatives of 20KR, 3 derivatives of 30KR and one of 0.2% EMS had below average stability with significantly higher performance. All these genotypes viz. line No.67, 57, 47, 42 13 and 30 had ability to express upto 5.47 under unfavourable and upto 2.7 under favourable conditions. All these genotypes had either average stability or below average, stability with mean performance superior over control.

A perusal of fig.(3) indicate the responsiveness of genotypes viz. line No.22, 21 and 2 of 15KR, line No.57, 69 and 84 of 20KR line No. 20, 46, 48 of 30KR and line No.29, of
0.2% EMS under favourable and unfavourable conditions. In control, response was narrow as it had 0.88% maturity coefficient (Mc) under unfavourable condition 0.73% maturity coefficient (Mc) under favourable condition whereas, all these genotypes had performance upto 0.58 under unfavourable conditions and upto 0.90 under favourable condition. Testing of these genotypes on large scale is worth. Consideration is also desirable to adopt intermating crossing amongst these genotypes. By adopting such breeding procedure, it may be possible to incorporate below average stability features for all the four characters in one genotype.

4 GENOTYPIC CORRELATION AND RECOMBINATION PERCENTAGE :-

Genotypic correlation gives an idea about ability of the mutagene to break the negative correlations existing between two desirable traits. It has been measured by studying trend and significant values. Efficacy of four mutagens was evaluated using these two parameters i.e. genotypic correction and recombination %. Treatment-wise results depicted in Table -12 along with control. Genotypic correlation were worked out for all characters, however, major emphasis in present investigation was given on studying nature of association of mean fibre length (MFL) with remaining 13 characters. In control population mean fibre length (MFL) has significant association with micronaire value and toughness in the negative direction. In irradiated population, results indicated impact of mutagenes as associations between mean fibre length (MFL) and
toughness changed from significant negative to non-significant positive in 0.2%EMS, 20KR and 15KR while it was significant positive in 30KR. These results suggest that mutagene has ability to change the direction of the association and intensity of association. Among the four mutagens, 30KR appeared more effective over rest of the treatments as it showed significant positive association. In respect of micronaire and maturity coefficient (Mc) the trend was similar in all the four mutagenic populations to that observed in the control. None of the mutagens proved effective in changing undesirable direction i.e., significant negative for micronaire and maturity coefficient (Mc) with mean fibre length (MFL), However intensity of this negative association was changed, though negative, it was non-significant in 20KR. From this point of view, use of 20KR could be an appropriate to select a longer genotypes without reducing mature fibre percentage (M%) and fiber fineness. Similar results were also reported by Yadao (1986).

5 EXTENT OF RECOMBINATION PERCENTAGE :-

Recombination percentage for these three characters depicted in Table 12 revealed relatively higher efficacy of 20KR and of 30KR for mean fibre length (MFL) with toughness.

Mean fibre length (MFL) had non-significant association in control population with T1 and Non significant negative with T0 and T2. Results also indicated that the trend in four mutagene was more or less same as that observed with
control population. However, in 30KR though non-significant, it was positive for T0, T2 and in 20KR for T1.

In respect of association of mean fibre length (MFL) with ginning outturn (GOT), boll weight (B.W.) and seed Index control population showed weak relationship either in positive or negative direction. In irradiated population, it was significant negative in 0.2% EMS while significant positive in 30KR. Mutagene with 30KR had ability to break negative relationship mean fibre length (MFL), ginning outturn (GOT) and seed index (SI) while 0.2% EMS showed strong positive association with boll weight.

In summarizing the results, It can be concluded amongst four mutagenes, 30KR followed 20KR had showed relatively higher ability over rest of the treatments either in changing direction from significant negative to non-significant but in positive direction. Mutagene 20KR in addition to this effect has ability to elevate the intensity for positive relationship. This mutagene has ability to generate population having association of mean fibre length (MFL) with boll weight (B.W.) from non-significant positive to significant positive direction.