6. SUMMARY AND CONCLUSIONS

The present investigation was carried out to study heterosis, combining ability, gene action and G X E interaction (stability) in sesame (*Sesamum indicum* L.). Eight females and six males were crossed by adopting line x tester mating design and resultant 48 hybrids were evaluated along with parents in Randomized Block Design (RBD) during summer (E₁), *kharif* (E₂) and *rabi* season (E₃), whereas F₂’s were evaluated during *rabi* season (E₃). TKG-22 national check variety used as standard check. Observations were recorded on seventeen quantitative traits. The results were discussed and concluded in the form of summary.

Analysis of variances revealed significant differences among parents and crosses for all the characters except days to flower initiation, days to maturity, capsule length and number of seeds per capsule.

Heterosis for seed yield per plant observed up to extent of 246.47%, 240.51% and 382.85% over mid parent, better parent and standard check respectively. Hybrids *viz.*, GSM-22 x SI-331517, SI-3218 x Lalguda local, SI-3218 x S-0434, SI-3218 x SI-331517, IC-413202 x S-0434, IC-413204 x S-0434 recorded significant positive heterosis for seed yield per plant along with major yield components during summer season (E₁). Hybrids *viz.*, GSM-22 x KMS-5-873, GSM-22 x SI-331517, IC-413204 x KMR-116, IC-413204 x Lalguda local and IC-413204 x S-0434 were recorded desirable significant heterosis for seed yield and major yield components during *kharif* season (E₂). Hybrids *viz.*, GSM-22 x Lalguda local, IC-413209 x KMS-5-873, IC-413231 x Lalguda local, ES-111-284 x KMS-5-873 and ES-111-284 x SI-331517 were recorded desirable heterosis for seed yield per plant along with other major yield attributes during *rabi* season (E₃). Limited heterosis observed for days to flower initiation, days to 50 percent flowering, days to maturity, capsule length, 1000 seed weight and oil content.

Parental lines *viz.*, GSM-22, SI-3218, SI-331517, S-0434 and Lalguda
local were good combiners for seed yield and major yield contributing character during summer season \((E_1)\), whereas during \textit{kharif} season IC-413204, GSM-22 and Lalguda local were good combiners for seed yield and yield components; and during \textit{rabi} season \((E_3)\) ES-111-284, IC-413231, GSM-22 and Lalguda local were good combiners for seed yield per plant along with major yield components. These lines should be utilized for further hybridization. Parents GSM-22 and Lalguda local were found good combiners over the season for seed yield per plant and yield components. It’s revealed in few cases, that parents with low \textit{per se} performance recorded good combining ability and visa versa.

Hybrids IC-413204 x S-0434, IC-413208 x KMR-116, SI-3218 x Lalguda local and GSM-22 x KMS-5-873 were good combiners for seed yield per plant along with yield components during summer season \((E_1)\), whereas hybrids IC-413231 x KMR-116, IC-413204 x S-0434, GSM-22 x SI-331517 and GSM-22 x Lalguda local were shown good specific combining ability for seed yield along with other major yield components in \textit{kharif} season \((E_2)\); in \textit{rabi} season \((E_3)\) hybrid SI-3218 x Lalguda local, IC-413202 x KMR-116, IC-413202 x SI-331517, IC-413209 x KMS-5-873 and IC-413208 x KMR-116 were good combiners for seed yield per plant along with major yield contributing characters. These crosses consist of parents with mostly high x high, high x medium, high x low, medium x low \textit{gca} effects for seed yield and yield components; however some heterotic crosses consist of parents with low x low \textit{gca} effects.

Combining ability variances and gene action study revealed higher estimates of SCA variance than GCA variance for all the characters except days to flower initiation during summer seasons and days to 50 percent flowering and days to maturity over the season. The dominance variance was higher than additive variance for all the characters, except days to 50 percent flowering and days to maturity. The ratio of GCA variance to SCA variance was less than unity for all the characters, indicates that characters were predominantly governed by non-additive gene action.
Stability analysis revealed that kharif season \((E_2)\) was most favorable for most of the plant growth related traits including plant height and number of primary branches, however for seed yield per plant rabi season was the most favorable environment followed by kharif season. The genotype x environment interaction was significant for all the characters except days to 50 percent flowering, days to maturity and number of seeds per capsule. Both linear (predictable) and non-linear (un-predictable) components significantly contributed to genotype x environmental interactions for seed yield per plant and yield components, therefore part of variation in these characters was unpredictable. Stability of the genotypes assessed as per the criteria suggested by Eberhart and Russell (1966). None of the genotype shown stable performance for all the traits, also there was absence of stability among the genotypes for seed yield per plant. Genotypes \textit{viz.}, ES-111-284 x KMS-5-343, ES-111-284 x Lalguda local, IC-413204 x S-0434, IC-413204 x Lalguda local, IC-413209 x Lalguda local, IC-413202 x Lalguda local, GSM-22 x Lalguda local, SI-3218 x S-0434 and GSM-22 were recorded high mean over the season but were unstable genotypes. Parent IC-413231 and Hybrid SI-3218 x Lalguda local and IC-413231 x S-0434 were shown below average stability and suitable for favourable environments, and should be selected for cultivation in rabi and kharif season. Hybrids IC-413208 x S-0434 and GSM-22 x KMS-5-873 having high mean were above average stable genotypes and highly desirable as specifically adapted to stress or poor environments. These hybrids should be tested at drought prone areas or in summer season with supplemented irrigation.

Inbreeding depression was observed for all the traits including seed yield per plant. Cross IC-413202 x KMR-116 (43.64%) recorded highest inbreeding depression. However, negative inbreeding depression also observed up to extent of -161.54%. Crosses \textit{viz.}, ES-111-284 x SI-331517, ES-111-284 x KMS-5-873, IC-413231 x KMS-5-873, IC-413208 x KMS-5-873, IC-413204 x KMS-5-873, IC-413202 x Lalguda local, GSM-22 x SI-
331517 and GSM-22 x KMS-5-873 with significant positive relative heterosis revealed significant inbreeding vigor in F\textsubscript{2} generation.

The average cost (Rs. 4826.12) occurred to produce 1 kg of hybrid seeds was quite high in comparison to prices of available varieties. Therefore, residual heterosis could be exploited to reduce the cost of F\textsubscript{1} seeds. Hybrids \textit{viz.}, IC-413231 x KMR-116 (-99.58%), IC-413208 x KMS-5-873 (-75.06%), IC-413208 x SI-331517 (-93.70%) and IC-413208 x SI-331517 (-66.45%) could be exploited commercially as F\textsubscript{2} hybrid, because these having substantial amount of inbreeding vigor and parents with both white colored seeds. Two crosses SI-3218 x S-0434 (-39.81%) and GSM-22 x S-0434 (-32.89%) could be exploited as F\textsubscript{2} hybrids in black color, as both parents were having black colored seeds.

Therefore, findings of present investigations were concluded as below.

1. Genetic variability is essential for high heterosis, as evidenced from analysis of variance and heterosis estimates for the characters \textit{viz.}, days to flower initiation, days to maturity, capsule length and number of seeds per capsule.

2. Substantial amount of heterosis observed for seed yield per plant and yield components. Hybrids \textit{viz.}, GSM-22 x SI-331517, SI-3218 x Lalguda local, SI-3218 x S-0434, SI-3218 x SI-331517, IC-413202 x S-0434, IC-413204 x S-0434, GSM-22 x KMS-5-873, IC-413204 x KMR-116, IC-413204 x Lalguda local, GSM-22 x Lalguda local, IC-413209 x KMS-5-873, IC-413231 x Lalguda local, ES-111-284 x KMS-5-873 and ES-111-284 x SI-331517 should be tested over multiple location to confirm heterotic performance observed in current study. These hybrids could be exploited for isolating transgressive segregants for yield and yield contributing characters in later generations.

3. Parental lines \textit{viz.}, GSM-22, SI-3218, SI-331517, S-0434 and Lalguda IC-413204, ES-111-284 and IC-413231 were found good combiners for seed yield per plant and yield components. These lines should be utilized
for further hybridization. It's revealed that parents with low *per se* performance also recorded good combining ability and visa versa. Therefore parents should be selected on the basis of general combining ability estimates instead of *per se* performance alone.

4. Hybrids with good specific combining ability for seed yield per plant along with major yield contributing characters were consist of parents with mostly high x high, high x medium, high x low, medium x low *gca* effects. It's evidenced that parents with low or medium *gca* effects involved in crosses with high *sca* effects, therefore its not necessary to attempt crosses always between parents with high *gca* effects.

5. Combining ability variances and gene action study revealed that most of the characters were predominantly governed by non-additive gene action and improvement should emphasize through specific combining ability.

6. Both linear (predictable) and non-linear (un-predictable) components significantly contributed to genotype x environmental interactions for seed yield per plant and yield components and part of variation in these characters was unpredictable. Further, there was no stability for seed yield either in parents and hybrids.

7. Substantial amount of residual heterosis observed in F₂ generation of the heterotic crosses *viz.*, IC-413231 x KMR-116, IC-413208 x KMS-5-873, IC-413208 x SI-331517, IC-413208 x SI-331517, SI-3218 x S-0434 and GSM-22 x S-0434, these F₂ hybrids could be exploited with reduced seed price for commercial cultivation after confirming the level of heterosis over multi-locations.