Chapter V

SUMMARY AND CONCLUSION
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SUMMARY

On the basis of diversity in vegetative and reproductive characters, the 8 genotypes including the high yielding varieties for West Bengal B-67, B-14 and B-9; the exotic variety R-9; the endemic variety T-12 as well as the selections MT-67-52, RT-4 and TC-25 were chosen for the present study. The 8 sesame parents were grown at the University Research Farm, Kalyani during the kharif season of the first and second year in two 3 m long rows with a spacing of 50 cm x 8 cm between the rows and plants in a row for each sesame variety. The recommended intercultural operations were carried out and control measures were taken to protect the crop from pests and diseases. The competitive plants of each sesame variety were randomly chosen and crossed in all possible combinations excluding reciprocals in both the years.

During the pre-kharif seasons of the second and third year, 36 treatments including 8 sesame parents and 28 hybrids obtained from a 8 x 8 diallel cross (excluding reciprocals) were grown at the University Research Farm, Kalyani in randomized block design with four replications. One row of 3 m length was allotted in each replication for each sesame parent and hybrid with 50 cm x 8 cm spacing between the rows and plants in a row. Crop management was similar to that of growing sesame parents. Ten competitive plants grown in each row of the four replications were tagged and records on plant height, number of primary
branches, number of secondary branches, number of days to first flowering, flowering duration, number of days to maturity, number of capsules per plant, number of shattered capsules per plant, number of seeds per capsule, 1000-seed weight, seed yield per plant, oil content and oil yield per plant were taken during both the seasons. Oil content was estimated by Nuclear Magnetic Resonance Spectrometer by courtesy of the Oilseeds Research Institute, Hyderabad. Oil yield per plant was calculated from the product of oil content and seed yield of the respective sesame plant.

The influence of season on growth and seed yield components of 8 sesame parents was studied in the two consecutive pre-kharif seasons and the response of them was compared in both the seasons. Mean plant height of sesame parent was comparatively higher and range of plant height was generally wider in the first season than in the second season. Consequently, range of variation in the number of primary and secondary branches were also reduced indicating a general effect of reduction of growth of the main stem in the second season. In general, all sesame parents have taken more number of days to first flowering, less flowering duration and less number of days to maturity in the first season. R-9 have shown earliness to first flowering and maturity in both the seasons. Mean value of number of capsules per plant was higher in the first season than in the second season. Seed yield per plant and oil yield per plant differed appreciably during both the seasons in all sesame parents excepting B-9. Moreover, oil content in sesame parents varied in respect of lighter or heavier seeds as revealed from 1000-seed weight.

Range and mean values for seed yield per plant in $F_1$ hybrids were higher in the first season than in the second season.
Meteorological records from January to July covering the cropping period during the two consecutive pre-kharif seasons courtesy of the Department of Plant Pathology, Bidhan Chandra Krishi Viswavidyalaya. The difference between maximum and minimum temperature being similar during both the seasons, the extreme rise of minimum temperature during April in the second season reduced the difference between maximum and minimum temperature. Relative humidity was low in March in both the seasons. Rainfall was low during the first three months, while heavy rainfall followed during the later months. However, average rainfall between May and July of the first season was higher compared to the second season.

Variance analysis revealed that mean sum of square due to treatments, which include sesame parents and F1 hybrids were significant at 5% level of probability for all the traits during the two consecutive pre-kharif seasons excepting for flowering duration, number of days to maturity and oil yield per plant in the second season.

Estimates of components of variance and broad sense heritability were conducted for number of primary branches, number of secondary branches, flowering duration, number of capsules per plant, number of seeds per capsule, 1000-seed weight, seed yield per plant and oil yield per plant from data obtained in the first and second season separately. In both the seasons, phenotypic coefficient of variation was higher than genotypic coefficient of variation for the corresponding yield contributing character, indicating thereby that environmental variance must have played an important role. Highest value of broad sense heritability for number of seeds per capsule in both the seasons indicated that this trait may be taken into consideration for breeding improvement of seed yield per plant.
High values of regression coefficient for number of capsules per plant with seed yield per plant and number of seeds per capsule with 1000-seed weight in the two consecutive pre-kharif seasons indicated that both additive and non-additive gene effects were responsible for these variables. However, regression coefficient value of both the seasons showed that number of secondary branches, number of capsules per plant, 1000-seed weight, seed yield per plant and oil yield per plant were very closely related.

Variance analysis of regression demonstrated that mean sum of square for regression of number of primary branches on seed yield per plant, number of secondary branches on number of capsules per plant as well as seed yield per plant and number of capsules per plant on seed yield per plant as well as oil yield per plant were significant at 5% level of probability during the two consecutive pre-kharif seasons.

On the basis of covariance analysis, it was apparent that the climatic differences in the two consecutive pre-kharif seasons have possibly imposed the emphasis on different plant characters.

Estimates of components of covariance revealed that phenotypic covariance was higher than genotypic covariance for the corresponding yield contributing character in the two consecutive pre-kharif seasons. In the first season, coheritability values were high for flowering duration with number of capsules per plant as well as with seed yield per plant; while in the second season, the same was highest for number of secondary branches with number of capsules per plant.

Estimates of correlation coefficient during the two consecutive pre-kharif seasons revealed that the improvement of seed and oil yield per
plant along with the simultaneous upgrading of the yield contributing characters like number of primary branches, number of secondary branches and number of capsules per plant may go a long way in maximizing the productivity through pure line selection, if additive genetic variance play an important role in the control of these plant characters.

The results of path analysis from the two consecutive pre-kharif seasons proved that number of capsules per plant was the important direct contributor to high seed and oil yield per plant in sesame. Indirect contribution of number of primary/secondary branches pointed out the characteristic developmental phases of sesame plant. Thus, it may be assumed that a sesame plant type with semi-bushy habit, having more capsule bearing secondary branches arising from the first few nodes of the main stem would be the ideal architecture for high production of seed and oil yield.

Variance analysis of combining ability revealed that mean square due to gca and sca were significant for all plant characters in the two consecutive pre-kharif seasons. Both additive and non-additive gene effects were responsible for the control of the different traits.

General combiners with highest gca effect during the two consecutive pre-kharif seasons were B-9 for number of primary branches, R-9 for number of shattered capsules per plant and B-14 for number of seeds per capsule. However, gca effect of 8 sesame parents indicated that B-14, B-9, R-9, MT-67-52 and RT-4 can be further used for an intermating population involving all possible cross combinations in order to achieve a breakthrough in seed and oil yield per plant. Gca effect during both the
seasons was found to be wider in respect of plant height, number of capsules per plant, number of shattered capsules per plant, number of seeds per capsule and oil yield per plant compared to that of number of primary branches, number of secondary branches, number of days to first flowering, number of days to maturity, 1000-seed weight and seed yield per plant.

Best specific combiners during the two consecutive pre-kharif seasons were B-14 x RT-4 for plant height and B-9 x RT-4 for number of seeds per capsule. Estimates of sca effect of 28 cross combinations in sesame revealed that the best cross combinations for yield and yield components involved the high x high, high x low as well as low x low combinations between sesame parents of high and low gca effects. Sca effect estimated for both the seasons, however, differed appreciably for plant height and oil yield per plant in all cross combinations and for number of capsules per plant in a few cross combinations.

Per cent heterobeltiosis for oil content of 28 cross combinations in F1 generation during the two consecutive pre-kharif seasons indicated that majority of cross combinations have shown negative heterobeltiosis. As such, heterosis breeding for oil content in sesame was proved to be unsuitable. However, a remarkable case has been noted, where cross combination MT-67-52 x TC-25 have shown highly significant positive heterobeltiosis at 1% level of probability in the first season and significant negative heterobeltiosis at 5% level of probability in the second season. This may be possibly due to the differential response of the environment, affecting thereby variation of oil yielding character.

Per cent heterobeltiosis for 1000-seed weight and seed yield per plant of 45 double cross combinations revealed that majority of cross
combinations have shown highly significant positive heterobeltiosis at 1% level of probability for 1000-seed weight and seed yield per plant. The increased vigour noted at least for seed yield per plant in double cross combinations (B-14 x T-12) x (R-9 x MT-67-52) and (B-14 x T-12) x (B-9 x R-9), may be mainly due to accumulation of favourable additive genes and complementary epistasis, which may be fixable. However, the 2 double cross combinations involved sesame parents and single cross combination with high gca and sca effects respectively for certain plant characters. Based on these findings, it can be suggested that selection for number of primary branches, number of secondary branches, number of capsules per plant and number of seeds per capsule would be fruitful in the restructuring of sesame plant type for higher seed and oil yield.

CONCLUSION

With a view to achieve high seed yield per plant coupled with high oil content in seed, the strategy for better utilization of the available genetic resource would be to make intensive inter-crossing of the chosen sesame parents for transfer of the desirable plant characters into a gene pool, which would pave the way for providing the base genotype/s with advantageous association of yield contributing characters. Sesame parents B-14 and B-9 were identified to be the best (out of the 8 sesame parents studied), which may be used through appropriate breeding protocol for exploitation of both additive and non-additive gene effects.

Non-additive gene effect being higher than additive gene effect for number of capsules per plant and seed yield per plant, the breeding protocol would be initiated through proper selection of seed and pollen parents followed by recurrent selection through several cycles for high seed yield as well as other attributes influencing seed yield.
In order to gain high oil content of good quality in seed, adoption of single-seed descent method coupled with half-seed analysis with High Precision Liquid Chromatography in segregating sesame plants, would help to isolate high oil yielding genotypes with improved oil quality.

Future scope of research will involve diversification of sesame plant type for different cropping systems (solo cropping and mixed cropping). Sesame plant type with semi-bushy habit would be best suited for solo cropping system. Since inheritance studies and path analysis revealed the contribution of number of primary branches, number of secondary branches and number of capsules per plant as the major contribution to yield, future research is needed to determine the optimal number of primary and secondary branches, which would increase number of capsules per plant. The quality of seed oil in sesame is much superior to seed oil in Brassica. Seed oil content in sesame, as mentioned earlier, is also appreciably high, but highly variable. It is, therefore, necessary to stabilise oil content at the highest level of variation found i.e., 54%. The intra-varietal variation are to be minimized so as to bring homogeneity in respect of this trait by following the single-seed descent method.