

## GENERAL CONCLUSION

The results embodied in this thesis, besides elucidating many points of scientific interest relating to some agronomic practices for cotton, have brought about promises of great practical interest with regard to development of crop husbandry in the agro-climatic conditions of coastal alluvial region of eastern India. The studies have thrown immense light on the constraints and yield barriers, being confronted with the prospect of development of cotton husbandry and the results have specified ways and means to break-through the problems of developing production technology for cotton with manipulation of agro-techniques for the typical coastal alluvial region.

Planting dates have exerted marked effect on vegetative growth, physiological growth parameters, ancillary characters, yield and fibre quality of cotton cultivars grown on rice fallow coastal alluvial lands. Earlier sowing on December 25 has appreciably and significantly improved important ancillary characters like the number of squares, flowers, bolls and weight of harvested bolls per plant. Delay in sowing has caused considerable reduction in ancillary characters. Earlier sowing on December 25 has resulted in significantly higher seed cotton yield to the extent of 38.89, 43.42 and 62.53 per cent over later planting on January 4, January 14 and January 24 respectively. Delay in sowing to January 24 has caused drastic reduction in yield of cotton as compared to earlier plantings. The increased seed cotton yield with early sowing may be attributed to higher number of flowers, matured bolls and weight of matured bolls per plant due to prevalence of favourable weather conditions such as temperature, light and humidity during different stages of growth of cotton planted in fourth week of December. Longer reproductive phase in early sowing might have helped in better manifestation of ancillary characters which in turn have led to higher yield in cotton. Successive reduction in seed cotton yield due to corresponding late sowing as compared to earlier planting is due to less number of harvested bolls and boll weight per plant. The late planted cotton crop is subjected to relatively lesser time span available for plant growth, especially, reproductive growth on account of early harvest of cotton just before onset of monsoon.

Cotton varieties tested have differed in respect of growth, yield attributes, yield and quality parameters on rice-fallow coastal alluvial land. Variety LRA -5166 has significantly out yielded other varieties like G.Cot -14, LH -900, H -777 and AKH -081. Variety LRA -5166 has shown 9.72, 6.02, 9.36 and 13.32 per cent increase in seed cotton yield over G.Cot -14, LH -900, H -777 and AKH -081 respectively, on rice fallow coastal alluvial land. Such increased yield in variety LRA -5166 is ascribed to appreciably more number of squares, flowers, bolls and

harvested bolls per plant and boll weight per plant, besides better manifestation of physiological parameters like LAI, dry matter, CGR and NAR through increased metabolic activities and increased rate of photosynthesis. The results convincingly indicate the superiority of 'LRA -5166' cotton over rest of the varieties because of greater stability in yield and wider adaptability under rice fallow coastal alluvial land. Variety G.Cot -14 has also performed better than LH -900, H -777 and AKH -081. Variety AKH -081 has proved to be the lowest yielder.

Interaction between sowing dates and varieties has indicated progressive increasing trend of cotton yield with corresponding advancement in planting dates on rice fallow coastal alluvial lands. Similarly, early sowing on December 25 has shown 38.55, 40.32, 68.06 per cent higher lint yield over later sowings on January 4, January 14 and January 24 respectively. Increase in lint yield under earlier sowing is presumed to be due to higher seed cotton yield and increased ginning outturn. Variety LRA -5166 remaining at par with G.Cot -14 has given higher yield of lint over others mainly by improvement of seed cotton yield and ginning outturn.

Quality characters of cotton fibre have been significantly influenced by sowing dates and varieties when cotton is grown on rice fallow coastal alluvial lands. Results obtained indicate a scope of improving the quality of fibre through timely planting on rice fallow land. Early sowing on December 25 has improved the fibre length, uniformity ratio and bundle strength (tenacity) of cotton fibre over delayed plantings on January 4, January 14 and January 24. However, fineness of fibre has considerably increased with late sowing dates.

Cotton varieties have greatly varied in respect of fibre quality. "AKH -081" cotton has higher span length over rest of the varieties. Variety LH -900 has higher uniformity ratio followed by LRA -5166. Fibre of G.Cot -14 cotton is finer than that of others. Bundle strength (tenacity) of "LH-900" cotton at '0' gauge and "H -777" at  $\frac{1}{8}$ ' gauge is higher than that of other varieties. There is not a single variety having better quality in respect of two or more parameters as tested when cotton is grown on rice fallow coastal alluvial land.

The results, in general, convincingly indicate that for realising higher yields of cotton in rice fallow rainfed coastal alluvial lands, wide<sup>ly</sup> adaptable varieties like LRA -5166 and G.Cot -14 should be preferred and planted within fourth week of December.

Methods of planting have greatly affected growth, development, ancillary characters and yield of cotton raised under different inter-row and intra-row spacings.

As regards the effects of method and geometry of planting on cotton, the results have clearly indicated that transplanting method and intermediate inter-row (60 cm) and intra-row (45 cm) spacings have pronounced beneficial effects on growth, ancillary characters and economic yield of the crop on rice fallow coastal alluvial land. Transplanting method has proved superior and has recorded higher seed cotton yield than direct sowing due to improvement in plant productivity in terms of ancillary characters. The increased yield by nearly 17 per cent with transplanting method might be attributed to early sowing and establishment of the crop by 30 days compared with direct sowing on rice fallow land. The transplanted crop has clear advantage of at least four weeks of advanced sowing over normal time of planting and this period has proved to be of vital importance for early start of the crop. The results indicate that transplanting of four week old healthy seedlings might result in escape of ill effects of environments on growth under delayed planting on rice fallows. The results of the study has brought out the superiority of transplanting over the conventional direct sowing when cotton is grown on rice fallow land. Under delayed sowing conditions, due to late harvest of preceding rice crop, raising seedlings in advance and transplanting 30 days old seedlings would result in increased yield over direct sowing. The results suggest that in case the fields are occupied by the previous crops till late in the season, transplanting is more advantageous over direct sowing under delayed sowing conditions.

Furthermore, ascertaining optimum inter and intra row spacing is of paramount importance for realising higher yield in cotton. The results have clearly indicated that for realising higher seed cotton yield, intermediate row spacing of 60 cm is significantly superior to either wider (75 cm) or narrower (45 cm) inter row spacings. Increased yield with intermediate (60 cm) row-spacing may be attributable to efficient interception of solar radiation as well as efficient utilization of soil environments. Intermediate row spacing might have created favourable conditions for vegetative as well as reproductive growth in cotton resulting in higher yield in crop over other row spacings. Similarly, intermediate intra-row spacing (45 cm) has proved most beneficial than closer (30 cm) and wider (60 cm) intra row spacing in enhancing cotton yield. The increased yield under intermediate intra-row spacing is mainly due to increase in number of bolls and weight of bolls per plant owing to better availability of soil and environmental resources. The results clearly indicate that transplanting in closer rows of 45 cm with intermediate intra-row spacing of 45 cm seem to be most suitable combination for increasing yield of cotton on rainfed coastal alluvial land.

In general, transplanting method of cotton cultivation has given higher benefit : cost ratio which is 2.53 per cent higher over direct sowing. The results clearly indicate the superiority of transplanting method over direct sowing for realising higher monetary returns from cotton

cultivation on rice fallow coastal alluvial land.

Besides cultural manipulation, management of inputs especially judicious use of manures and fertilizers have also exhibited their prominent roles in increasing cotton productivity on rainfed rice fallow coastal alluvial land.

Application of 10 tonnes Farm Yard Manure (FYM) per hectare has resulted in 12.10 per cent increase in seed cotton yield over no FYM. The increased number of bolls and their weight under FYM have increased the yield of cotton supplied with 10 tonnes FYM /ha.

Application of N has proved most beneficial for increasing yield of cotton on rice fallow coastal alluvial land. Increased seed cotton yield to the tune of 22.05 q /ha has been obtained with application of 120 kg N /ha on coastal alluvial soil. Higher yield of seed cotton with application of 120 kg N /ha is presumed to be due to greater uptake and utilization of nutrients and subsequent enhancement of productive ( source) and storage (sink) capacity of cotton. The response function on observed yield of cotton has indicated its positive responsiveness to higher levels of N application on coastal alluvial land. The most profitable dose of N for cotton has been found to be 124.55 kg /ha under rice fallow coastal alluvial soil conditions.

Similarly, phosphorus fertilization in cotton under rainfed coastal alluvial land has been found to be beneficial in augmenting seed cotton yield. Application of 40 kg  $P_2O_5$  /ha has increased the yield by 7.16 and 20.08 per cent over 20 and 0 kg  $P_2O_5$  per hectare respectively. The increase in yield has been mainly brought about by overall improvement in growth parameters , a number of physiological parameters and yield contributing characters due to P-fertilization. It is assumed that extensive root development and improvement in plant growth by P application leading to higher photosynthetic activity and translocation of photosynthates to the 'sink' consequently has resulted in better development of ancillary characters and finally in higher seed cotton yield. The most profitable dose of P has been found to be 59.70 kg  $P_2O_5$  /ha for rainfed cotton on rice fallow coastal alluvial land.

The yield response to joint influence of FYM, N and P levels are the most noteworthy feature of the experiment conducted on nutrients. The results, in general, indicate that increased dose of either N or P are more effective in increasing cotton yield in presence of FYM only. The results, further, have indicated that both the levels of 80 and 120 kg N /ha are equally effective and efficient with 40 kg  $P_2O_5$  /ha in increasing yield of cotton in presence of FYM only. Such increase in yield under FYM at both higher levels of N in conjunction with higher levels of P has occurred possibly due to increased N and P use efficiency of cotton in presence of FYM.

Addition of FYM and application of increased doses of N and P have increased the net return per hectare in cotton cultivation. The increased margin of profit emerged from higher rate of N (120 kg /ha) and P (40 Kg  $P_2O_5$  /ha) is due to corresponding increase in yield under added levels of respective nutrients on coastal alluvial land. Increased uptake of nutrients under application of FYM, N and P may be attributed to increased availability of N and P in soil associated with improved absorbing and assimilation capacity of vigorous crop resulting in increased yield of cotton. Furthermore, the results clearly indicate that there is increase in residual nutrients status corresponding to application of respective nutrients, though the residual values are less than initial status, probably due to heavy removal of nutrients by the crop. The results justify the need of balanced application of N and P in conjunction with FYM for a long duration crop like cotton grown under rice fallow coastal alluvial soil conditions especially considering the fact to keep all round nutritional balance in soil system in long future.

Besides crop productivity, quality parameters of cotton fibre have also been greatly affected by FYM, N and P application on coastal alluvial land.

Supply of FYM has shown positive effect on improvement of span length, uniformity ratio, fineness and maturity percentage of fibre.

Application of N has also improved the span length, uniformity ratio and bundle strength at '0' gauge. However, the doses of N have shown differential effects on such parameters.

Application of lower rate of P (20 kg  $P_2O_5$ /ha) has improved the fibre uniformity, maturity percentage of fibre and bundle strength at '0' gauge. Further, higher rate of P (40 kg  $P_2O_5$ /ha) has significantly improved the bundle strength at  $1/8$  gauge.

The results thus suggest that for realising higher yield and return and better quality fibre of cotton on rice fallow coastal alluvial land, application of N and P in addition with FYM seems to be most important integrated fertilizer management practices for cotton cultivation.

The results on cotton based intercropping system have indicated considerable yield and monetary advantages with suitable intercrops in associated cropping system on rainfed rice fallow coastal alluvial land.

The results indicate that paired row planting has given significantly higher seed cotton yield than that of normal planting irrespective of cropping systems. Intercropping has reduced the yield of component crops compared with respective pure stands. Intercropping of either

groundnut or linseed (2 rows) has caused more loss in yield of paired row planted cotton than with association of greengram or sesame (1 row). Reduction in seed cotton yield compared with pure crop recorded is 9.36 per cent in green gram, 15.07 per cent in sesame, 32.07 per cent in groundnut and 31.83 per cent in linseed in association with 1 row of intercrop and 33.39, 33.31, 44.58 and 50.28 per cent in association with 2 rows of respective crops. Maximum reduction in cotton yield in association with greengram (1 row) might be attributed to the lack of perceptible degree of competition between them due to short duration nature of intercrop. The average reduction in economic yield of intercrops compared with pure stand is 29.16, 34.58, 31.72 and 77.65 per cent in greengram, sesame, groundnut and linseed respectively, irrespective of number of rows of intercrops. Despite reduction in yield of component crops in intercropping, the system has significantly increased the total productivity in terms of seed cotton equivalents compared to sole cropping of greengram, sesame, groundnut and linseed mainly due to increase in combined intercrop yields. Among the cropping systems, cotton + greengram (1 row) and cotton + groundnut (1 row) have led to higher total productivity to the extent of 17.45 and 8.9 per cent increase in cotton equivalent over sole cotton. This is attributed to higher combined intercrop yields as well as their values accrued from intercrop. This is probably due to the fact that the additional yield from intercrops has been higher than the loss of yield in cotton under intercropping system. The results clearly bring out that intercropping of greengram (1 row) with base crop of cotton is the most efficient system for realising higher seed cotton equivalent on rainfed rice fallow coastal alluvial land. The results, further, indicate that groundnut is most compatible crop which may enhance total productivity of cotton based intercropping system on rainfed rice fallow coastal lands.

In intercropping system, land use efficiency has ranged between 27 to 66 per cent compared with sole cropping indicating greater biological efficiency of intercropping systems. Maximum land use efficiency (66 %) has been achieved from cotton + greengram (1 row) system indicating thereby that 66 % more land is needed to produce the same yield from the crop component as sole crop. Intercropping system of cotton + greengram (1 row) has indicated a modest competitive ratio, aggressivity factor and has given a good value for the product of crowding co-efficient which in turn has proved the system more balanced in competitive abilities and efficient as an intercropping system on rainfed coastal alluvial land.

Intercropping of cotton + greengram (1 row) has resulted in higher monetary advantage followed by cotton + groundnut (1 row) indicating greater absolute value of genuine yield advantage in these systems. The higher monetary advantages are indicative of better cropping system. Similarly, cotton + greengram (1 row) and cotton + groundnut (1 row) have given higher net returns and benefit : cost ratio than sole crop of paired row planted cotton. Higher

benefit : cost ratio in cotton + greengram ( 1 row) system indicates that this system is economically viable. The results suggest that intercropping of cotton with greengram (1 row) may be a superior practice rather than growing cotton or greengram alone to increase the income per unit area with more profit per rupee invested under rainfed rice fallow coastal alluvial land of eastern India with special reference to West Bengal.

The most important features emerging out of the present investigations are determination of optimum date of sowing and selection of suitable variety, ascertainment of suitable method of planting alongwith optimum inter-row and intra-row spacings, judicious use of nitrogenous and phosphatic fertilizers and organic manuring and also determination of productive and profitable intercropping system which seem to be most important cultural and management practices for production of cotton on rice fallow coastal alluvial land as the manipulation of cultural practices and management of manure and fertilizer inputs and adoption of suitable intercropping systems have exerted remarkable influence on the productivity of cotton.

The prospect of introducing cotton as an important cash crop, hitherto not cultivated on rice fallow coastal alluvial land of West Bengal, is also revealed from these studies. The results thus suggest that adoption of agro-techniques as practiced in present studies may help in introduction of cotton on rice fallow coastal alluvial land and realise higher yields as well as economic returns from its cultivation.