CHAPTER X

CONCLUSIONS

The rain sowings of American Uplands normally practised in the Central India do not meet with favourable conditions for growth during the first two and a half months after sowings; consequently their vegetative structure remains small and subnormal producing a very small number of bolls. It has been conclusively shown by sowing date experiments that the cotton plant requires bright sunshine, higher temperatures and the absence of waterlogging in the soil for their normal growth during the early stages of its life cycle. Cotton sown towards the end of May up to the middle of June by well irrigation i.e., only two to four weeks before their normal sowing time in vogue at present is found to attain much greater height, internodes and dry weight per plant than the cotton sown with rains. Thus the advantage gained during the first three weeks of the pre-monsoon conditions is reflected on the whole life cycle of the plants even though after three weeks they meet with the same weather conditions as the rain sown crop. It appears that during the period of high temperatures and the optimum moisture conditions of the soil there is better development of the root system which enhances the shoot growth.

The cotton plant in Malwa produces growth in extension during the first 100 days after sowing while it puts very little in dry matter during that period. This was probably the
result of unfavourable weather conditions as low temperatures and cloudy days retard the photosynthetic activity. The real increase in dry matter begins in September with the return of bright weather when the plant becomes photosynthetically active. At that stage the extension growth declines. The effect of favourable weather and soil conditions during the early stages of growth can be seen from the curves of the relative growth rate and the net assimilation rate. They are much higher in the early stages in the pre-monsoon sowings than in the rain sowings. Thus the functional activities are high and the crop is found to grow at quicker rate. The pre-rain and the rain sowings showed a marked increase in their functional activities again in September-October when the monsoon conditions disappeared and bright weather set in.

When the crop is sown early, the flowering phase also sets in earlier than in the case of the rain sown crop. This finding was in contrast with the finding of Pastur and Mukhtar Singh (1944) in the Punjab where late sown crop came into flowering almost at the same time as the early sown crop. Another important difference in the flowering activity of the American cotton plant in the Punjab and in Malwa was that flowering occurred in flush showing a big peak in the Punjab while that was not the case in Malwa where the flowering was gradual showing a small rise in the month of October.

garly sowing induced early flowering and there was also a slightly lowering effect on the first fruiting node, but the
The enhanced vegetative growth of the pre-monsoon crops results in better reproductive capacity. They produce greater number of bolls, greater boll weight and consequently higher yields than the rain sowings. In all experiments the early sowings gave significantly much higher yield than the rain sowing. The level of the yield in the pre-monsoon sowings varied from seven to twelve maunds as against two to four maunds per acre in the rain sown crop. The better performance of pre-monsoon sowings than the rain sowings held good irrespective of the soil type. Better vegetative growth and higher yields were obtained on well drained as well as waterlogged lands. The level of yield in the case of the rain sown crop in waterlogged lands was extremely low and such lands should not be sown with cotton with rains.

The best sowing time appeared to be earlier on waterlogged lands than on well drained lands. The optimum sowing time on waterlogged lands was found to be between 25th May and 10th June and for well drained lands from 1st June to 20th June. The increase in yield obtained by early sowing was sufficiently high to meet extra cost of irrigation and leave a considerably high margin of profit.

The main difficulty of practising early sowings in this tract is the unavailability of irrigation water. There is no
canal irrigation at present but if the proposed Chambal project materialises cotton cultivation will be remunerative.

The effect of sowing date on fruiting coefficient was found to be interrelated with soil and seasonal conditions. In waterlogged fields or in years of high rainfall early sowings gave higher fruiting coefficient than rain sowings. In well drained fields and in years of low rainfall, rain sowings gave higher fruiting coefficient than early sowings.

Early sowing was also found to be most potent factor for inducing earliness in plants. The percentage of the crop in the first picking was very high as compared with the pro-rain sowings.

Spacing as a factor produced small differences in the vegetative as well as reproductive growth. Wider spacing produced slightly better plants with greater dry weight per plant but when the dry weight produced per unit area was considered closer spacing was better than wider spacing. The same remark applied to boll number and yield. The boll number and yield though were higher per plant basis but were lower per unit area basis in the wider spacing than under closer spacing. There was no effect of wider spacing on boll weight which was the same as in the case of closely spaced crop with some exceptions. Though the yield per acre in closely spaced crop was higher than in widely spaced crop, the latter was more efficient in production of seed cotton. The fruiting coefficient was higher in widely spaced crop than in closely
spaced crop. Similarly, the crop was earlier by 2 to 5 percent in closer spacings than in wider spacings.

Nine inches between rows and eight inches between plants or twelve inches between rows and six inches between plants was found to be the optimum spacing both for pre-rain sown and rain sown crop.

Nitrogen behaved like the early sowing date. Its application increased the vegetative as well as reproductive growth of the plant. It increased significantly the height, internode number, internodal length and the dry weight per plant. It also increased the lateral growth more than the extension growth. Nitrogen treated plants grew vigorously soon after sowing after which the growth declined comparatively. The functional activities were higher in the unmanured plants than in nitrogen treated plants in the later stages of growth because the untreated plants became more active after the termination of the monsoon season during which period its activities were suppressed from the beginning owing to adverse conditions. Nitrogen thus enhances vegetative growth in the early stages even though the weather conditions were not favourable for the rain sown crop.

The boll number, boll weight and yield all significantly increased when nitrogen was applied. The increase became greater in these characters as the level of nitrogen was increased. Nitrogen also like the early sowing had slightly lowering effect on the first fruiting node.
Nitrogen also increased the rate of flowering during the first half of the flowering phase. The rate of flowering was found to increase as the level of nitrogen was increased.

Nitrogen produced a remarkable effect on the rate of bolling which was much higher during the first half of the bolling period in the manured plants than in the case of unmanured plants. More bolls opened when nitrogen was applied in the early stages of bolling period making the crop thus early. The reverse was found to be the case in the later stages of bolling when unmanured plants showed an increased rate of bolling than the manured plants.

Nitrogen slightly increased the number of vegetative branches; but it had greater increasing effect on fruiting branches, number of fruiting nodes and bolls borne on them. The effect on setting percentages was, however, not constant from season to season. Nitrogen did not affect the distribution of the bolls on the different regions of the stem. The total number of bolls was equal on all the zones of the plant.

The efficiency of the crop for the production of seed cotton was found to increase on account of an application of nitrogen. Higher doses of nitrogen beyond 66 lbs. per acre did not further increase the fruiting coefficient.

A very interesting finding of this investigation was the hastening effect produced by nitrogen on the maturity of the crop. The buds, flowers and opened bolls appeared 8 to 10
days earlier in the manured plots than in the unmanured plots. The rate of flowering and the rate of bolting were higher in the early stages in the manured plots than in the case of unmanured plants. Thus the arrival of the crop in the manured plots was earlier by about 12% than in the control plots. Thus hastening effect on maturity and crop arrival of manuring was quite opposite to that found in the Punjab where manuring was found to make crop late by a fortnight.

The results of sixteen trials point to the conclusion that the odds in favour of obtaining profits from nitrogenous manuring with two to three maunds of ammonium sulphate are very high and there are good prospects of profitable returns up to five maunds especially if the present high prices of seed cotton are maintained. The general responsiveness of American cotton to nitrogenous manuring is now fully established and there seems little likelihood that weather conditions e.g., high rainfall and waterlogged conditions of the soil in some seasons will render the application of these amounts unprofitable.

Phosphate was found to increase slightly the vegetative and reproductive growth. The yield of seed cotton was also slightly higher in phosphate treated plots. The responses, however, varied from experiment to experiment; sometimes it occurred only in combination with nitrogen and sometimes it was found to operate independently.

The application of potash showed no effect either on the
vegetative or the reproductive growth of the crop in the Malwa conditions.

The results obtained on the interaction of sowing date with nitrogen on the vegetative growth were variable in different experiments. In some experiments the increases obtained as a result of application of nitrogen declined as the sowing date advanced while in other experiments there was no such decline. The early sowings gave higher increases in yield by nitrogen application than the rain sown crop. The increase also became greater as the level of nitrogen increased.

The effect of sowing date in combination with spacing did not come out constantly significant on any character. The height declined under each sowing as the spacing became wider and that was due to greater attack of jassids in widely spaced crop than on closely spaced crop as demonstrated by Dastur et al (1945). The dry weight per plant on the other hand increased as the spacing became wider. Thus maximum height and dry weight were attained under the combination of close spacing with early sowing. There was also an increase in boll number as the spacing became closer under all sowings but the maximum boll production occurred under the combination of close spacing with early sowing. The same remarks applied to yield. Thus close spacing and early sowing provided the optimum conditions for vegetative as well as reproductive growth.

Thus early sowing, close spacing and manuring proved that
the best combination for vegetative and reproductive growth and the maximum yields of cotton can be obtained by adopting this practice.

The investigations conducted to determine the relation of waterlogging with mineral uptake revealed that absorption of nitrogen and other minerals was reduced when waterlogging occurred, but there was rapid absorption of nitrogen and other minerals with the return of favourable weather conditions in September. These nutrients showed first accumulation in the leaves of the rain sowings to be utilized later at the time of boll maturation.

The analysis of soil for nitrate and ammoniacal nitrogen revealed that nitrate nitrogen content of the soil was low while that of ammoniacal nitrogen was high during the monsoon. When the rains ceased, nitrate nitrogen content increased while ammoniacal nitrogen content decreased.

A physiological comparison of the growth of the cotton plant growing in the Punjab and at Indore revealed interesting differences and similarities. The sandy soil and higher temperatures with bright sunshine in the Punjab produced a heavy vegetative structure with numerous secondary branches while the plant remained small and stunted under Indore conditions which were detrimental to rapid vegetative growth. The relative growth rate and the net assimilation rate were, therefore, higher in the Punjab than in Malwa. Though the
flowering started almost at the same time in both the tracts, the rate of flowering was ten times higher in the Punjab than at Indore. The flowering occurred in flush and declined equally rapidly giving rise to a sharp peak in the flowering curve, while no such peak was visible at Indore where the flowering was gradual. This difference in the rate of flowering was caused by the differences in the vegetative growth made by the plant under two conditions. Though the total number of flowers and bolls and the yield per plant were higher in the Punjab than at Indore, it was remarkable that the fruiting coefficients i.e., seed cotton produced for the total dry matter was nearly the same at both places. It was nearly 23% in the Punjab and 27% at Indore.

The red leaf at Indore generally appeared at the fruiting stage. When the normal fruiting season sets in there is a rapid depletion of food materials from the leaves to the developing bolls. This is accompanied by the senility of leaf tissues. Even in a normal looking leaf such senile cells especially at the tops and margins occur. The green pigment in such cells decompose and probably provide materials for the formation of anthocyanin pigments as soon as the temperatures begin to drop below 70°F. As the cell sap is acidic, the pigments turn red. As the depletion affects more and more leaves senility increases and consequently reddening increases as the season advances.
It may be stated here that anthocyanin pigments may develop on account of the operation of quite different causes than discussed above in different tracts and in different plants. The above conclusions hold good only for American Upland cottons grown in the Malwa tract.

This type of red leaf does not appear to affect adversely the yields as it appears late in the season when the crop is maturing. Another reason for this conclusion is the effect produced by sulphate of ammonia on leaf reddening and yield. Though the red leaf appeared a fortnight earlier in the manured plots, the yields of seed cotton were increased as compared with the yield in the control plots where leaf reddening occurred at a later stage. Thus this type of red leaf did not appear to affect the yields.

The study of the effect of the applications of trace elements to cotton under rain fed conditions in the Malwa tract on the yield of cotton have yielded interesting results. Out of the several elements tried copper, boron, zinc, manganese and chromium gave consistently higher yields varying from 10% to 25% above the normal than the untreated plants. The increase in yield was caused by an increase in boll production.

The plants in zinc, copper and manganese plots appeared greener than the plants in control plots. The crop was definitely early in these plots. The application of these
elements did not bring about an increase in the rate of oxidation of organic material in the soil. There was no greater uptake of nitrogen in the trace elements treated plants than in the control plants. There was, however, an indication of greater uptake of copper and zinc in the copper and zinc plots than in the control plants.

As the cost of trace elements is high and the increase in yield very small, these applications can only be economical if the effect of one application lasts for three years.