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Interspecific hybridization between diploid and tetraploid cultivated *Gossypium* spp and its role in cotton improvement–a review

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ABSTRACT : Cotton breeder have long been intersted in producing hybridys between *Gossypium arboreum* and *G. hirsutum* in order to combine several desirable characters. The crosses between these species are often unsuccessful because of the abortion of hybrid endosperm and embryo at early stages of their development. Interspecific hybridization between American and Asiatic cotton have been attempted for combining valuable characters like fibre fineness and strength of Egyption cotton and earliness strength of lint and hight yield of upland cotton. Natural crosssing occurs to the extent of 0.003 per cent between varieties of different chromosome number. Complete failure obtaining successful hybrids between American and Indian types was reported. Two antifical hybrids between *G. herbaceum* and *G. hirsutum* female obtained by pollinating over 1000 flowers after removing the whole corolla and staminal column were also reported. No success was obtained in efforts to induce polyploidy by means of callus. Attempts to produce hybrids between species of many plant qenera have resulted in non-viability of seed due to embryo abortion.

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Seed germination and vegetative propagation studies in wild cotton (*Gossypium* spp.)

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ABSTRACT : Experiment were carried out to standardize a method for seed germination in wild cotton species and also to find out the effect of different concentrations of IBA on rooting and survival percentage of cuttings of different wild cotton species. Results indicated that seeds treated with 300 ppm GA_3 for 48 h in dark at 20°C resulted in better germinability of 63 per cent and survival of 51 per cent than the control having 25 per cent germinability and 11 per cent of survival. In vegetative propagation studies, there was a pronounced effect of 2000 ppm IBA, which induced profuse rooting and survival percentage as well as in other attributes. The plant growth regulator IBA 2000 ppm was found superior with regards to percentage success of rooted cuttings in *Gossypium armourianum* (88.89). Among the wild cotton species, *G. armourianum* semi hard wood produced significantly more number of roots (8.66) with increased root length (19.6 cm) per cutting and the survival percentage was significantly higher in *G. davidsonii* (94.33) in 2000 ppm of IBA than the untreated cuttings.

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Genetic evaluation of *Gossypium hirsutum* genotypes for yield, drought parameters and fibre quality

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ABSTRACT : Twenty genotypes of American cotton (*Gossypium hirsutum* L.) were evaluated for estimating the genetic variability, heritability and genetic advance as percent of mean during *kharif,* 2003-2004 at Regional Agricultural Research Station, Lam, Gunture for yield, yield components, besides drought tolerance traits and fibre properties. The genotype GShv 97/612 had highest mean performance for number of sympodia and seed cotton yield plant^{-1}. The number of bolls plant^{-1} was high in L 762. Boll weight and seed index were high in H 1250. The genotype SCS 37 recorded the highest mean performance for lint index and the genotype NH 545 ginning out turn. Regarding drought tolerance parameters, the genotype GShv 97/612 recorded the highest mean value for dry matter production. Relative water content, chlorophyll a and total chlorophyll contents in leaves were high in CPD 446. The genotypes SCS 37, GBhv 139 and L 762 recorded the highest mean values for specific leaf area (SLA), specific leaf weight (SLW) and chlorophyll stability index (CSI) respectively. The mean performance of different genotypes for fibre quality parameters varied. The genotypes KH 134 (2.5% span length), RAH 30 (bundle strength), PUSA 8-62 (fineness of the fibre) and GShv 97/612 (uniformity ratio) recorded highest values. The estimates of genotypic coefficient of correlation (GCV) and phenotypic coefficient of correlation (PCV) were high for number of bolls and seed cotton yield plant^{-1} (g). Drought tolerance parameters *viz.,* SLW, CSI and drymatter production plant^{-1} (DMP) showed considerable variation. Fibre properties *viz.,* 2.5 per cent span length and micronaire also exhibits variation. The PCV was greater than GCV. Heritability estimates were high for SLW, CSI, DMP, 2.5 per cent span length and bundle strength indicating the amenability in selection process. High heritability couped with high genetic advance was observed for DMP and micronaire characters indicating the operation of additive gene action thereby indicating the amenability of these traits in selection process.

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Stability analysis for seed cotton yield and its component traits in intra-specific hybrids of *Gossypium hirsutum*

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ABSTRACT : Stability analysis was carried out in 12 intra-*hirsutum* conventional hybrids for seed cotton yield and its component traits *viz.,* lint yield, ginning out turn and fibre quality traits i. e. 2.5 per cent span length, micronaire value and bundle strength on three years data *viz.,* 2001, 2002 and 2003. Varieties were significant for all the traits, except, bundle strength (g/tex). Variety x environment interaction was significant for all the characters, except boll weight and micronaire value, indicating differentiate expression of genotypes for the characters studied. Similarly, the environment (linear) component was significant for all the characters. However, magnitude of linear component was relatively more than the non linear component. Pooled deviation (non linear) was significant for all the characters, reflecting considerable genetic diversity in the material. Based on the linear component (bi), non linear response (S^2d) and mean performance, it was found that the hybrids CSHH 198, CSHH 238 and Om Shankar were most stable genotypes for overall environments.

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Introgression - a new tool for quality and yield improvement in diploid cotton and its heterosis and combining ability

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ABSTRACT : Three released varieties as lines and six introgressed material i.e., *Gossypium hirsutum* x *Gossypium herbaceum* and *Gossypium arboreum* x *Gossypium hirsutum* were crossed using line x tester matting design to assess the heterosis and combining ability effects for seed cotton yield/plant, 2.5 per cent span length, uniformity ratio, micronaire value, fibre strength and maturity co-efficient. The mean squares for parents and hybrids were significant for majority of the characters and indicated genetic diversity among the parents. The estimate of *gca* effects revealed that G. Cot 23 showing positive significant *gca* effect for seed cotton yield; and AH 32-3 for 2.5 per cent span length, micronaire value and maturity co-efficient in desired direction proved best general combiners. The variance due to *gca* and *sca* was non significant and *gca : sca* ratio indicated additive gene action for these traits. High heterobeltiotic effects for seed cotton yield/plot were noticed. The crosses, Sanjay x Hh 3-71, G. Cot 17 x AKA 01-4 and G. Cot 23 x AH 32-3 exhibited significant positive heterobeltiosis as well as *sca* effects for seed cotton yield.

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Combining ability studies for yield and quality traits in upland cotton (*Gossypium hirsutum* L.)

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ABSTRACT : The present study was undertaken to study the combining ability effects with a view to determine the inherent potential of parental stocks to produce high yielding hybrids. For this purpose, 48 upland cotton hybrids were developed crossing 16 lines with three testers in a line x tester design during *kharif* 2003. These hybrids alongwith their 19 parents (3 females and 16 males) and one standard check (HHH 223) were evaluated during *kharif*, 2004 at Cotton Research Station, Sirsa. The combining ability analysis revealed that both additive and non-additive variances were present inthe expression of all the characters with the former playing major role for majority of the characters. Highest *sca* effects for seed cotton yield were recorded for the hybrids HS 88 x TH 46 and H 777 x G 17. However, they were poor in *per se*. The study of *gca* effects revealed that male parent LAS 5 Red AK was the best general combiner for seed cotton yield and lint index. Male parents RS 875 and Gumbo delta type were best general combiners for boll number and boll weight, respectively. For number of monopods TH 46 and for number of sympods Gumbo delta type were best combiners. PIL 60 showed highest *gca* effect for earliness whereas PIL 27 showed maximum *gca* effects for seed index. For quality characters, ginning out turn and halo length male parents SK 663 and G. Cot 12 showed highest *gca* effects, respectively. Among female parents, HS 6 was the best general combiner, as it recorded highest *gca* effect for seed cotton yield, number of bolls, boll weight, seed index, ginning out turn and lint index. In general, none of the male of female parent was found to possess high *gca* effects for all the characters under study. The respective best combiners for various traits could be used for improvement in that trait. However, considering the economic importance of various characters LAS 5 Red AK, RS 875, SK 663 and Gumbo delta type among the males and HS 6 among the females may be used in future breeding programmes.

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Stability of yield and other quantitative traits in upland cotton

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ABSTRACT : In 6 parents and 15 F_1's of *Gossypium hirsutum* L., genotypes x environment (linear) effect was found to be significant for seed cotton yield, biomass and dry matter production potential, whereas pooled deviation (non-linear) was important for harvest index.Stability parameters revealed that the hybrids LRA-5166 x NDH-1002, LRA-5166 x NDH-1010 were stable for seed cotton yield. The hybrids were found superior to the parents for seed cotton yield and yield components. The cross combinations having involvement of robust x compact parents showed consistent performance for yield while robust x robust and robust x compact hybrids were found more efficient for yield and could be suitable for low management situations under rainfed condition.

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Genetic variability and association study for yield and its component traits in upland cotton (*Gossypium hirsutum* L.)

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ABSTRACT : Genetic variability, heritability, genetic advance, correlations and path coefficient analysis was carried out in 10 x 10 diallel (excluding reciprocals). The expression of all the traits indicated least influence of environment as they showed small differences between GCV and respective PCV. Number of monopodia/plant, bolls/plant and seed cotton yield/plant exhibited high heritability coupled with high genetic advance. Seed cotton yield revealed significant and positive association with plant height, sympodia/plant, bolls/plant and fibre foneness. Days to flowering, ginning percentage, lint index and 2.5

per cent span length showed negative correlations with seed cotton yield. Path analysis indicated that characters such as bolls/plant, plant height, fibre fineness and sympodia/plant were most important for selecting high yielding genotypes as they exerted significant positive correlations as well as positive direct effect on seed cotton yield. Selection based on these characters may contribute considerably to improvement in the seed cotton yield.

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Ethephon as a chemical hybridization agent for *Gossypium hirsutum* and *G. arboreum* L.

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ABSTRACT : Efficacy of ethephon or ethrel (2-chloroethyl phosphonic acid) as a chemical hybridizing agents in *Gossypium hirsutum* L. var. Pusa 846 and *Gossypium arboreum* L. var. RG 8 was tested. Foliar sprays of aqueous solutions of 0.1, 0.2 and 0.3T ($^{v}/_{v}$) ethrel induced pollen sterility ranging from 96.8-100 per cent lasting for 22-25 days. This was associated with significant reduction in total yield in spite of the fact that all the treatments of 0.2 and 0.3 per cent ethrel exhibited significant increase in the number of flowers/plant in *G. hirsutum.* However, the plants of both the species of cotton treated once with 0.1 per cent ethrel exhibited in significant increase in pistil length, number of ovules/ovary, boll weight, number of seeds/boll, hundred seed and lint weight. Thus, results of present study clearly indicated that one spray of 0.1 per cent ethrel before floral bud initiation was useful in inducing high degree of pollen sterility with less reduction yield parameters in both the species and these male sterile plants could be exploited for hybrid seed production.

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Variability studies in cotton growing states for implementation of quality seed distribution and production of breeder seed components under ICDP-cotton scheme

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ABSTRACT : Performance of the distribution of certified seed and production of breeder seed under Intensive Cotton Development Program implemented during 1992-93 to 2000-01 by Crop Division of Department of Agriculture and Coorperation, Ministry of Agriculture, Government of India in 11 cotton growing states was studies. More than 70 per cent targets were achieved during 1992-93 to 1994-95 and 1996-97 to 1997-98 for distribution of seed. For breeder seed production also in years 1992-93 to 1995-96 targets achieved were more than 70 per cent. State wise analysis indicated that the distribution of certified seed per cent achievement varied from 1.78 in Karnataka during 1998-99 to 287.00 in U. P. for 1997-98. The states of Haryana, Punjab, Rajasthan, Tamil Nadu and U. P. reported significantly higher than average and more than 100 per cent implementation of the quality seed distribution component for one or more years. Complete implementation of the component by Karnataka and Maharashtra was reported during 1995-96 and 1996-97, respectively. Per cent breeder seed production achievement against the target set for the 11 cotton growing States ranged from 1.50 in Tamil Nadu during 1996-97 to 350.56 in Haryana during 1995-96. The per cent achievement for breeder seed production in Gujarat, Haryana, Maharahstra and Rajasthan was more than 100 per cent and significantly higher than average for one or more years and targets were fully achieved by Tamil Nadu and Uttar Pradesh for one or more years.

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Genetic variability of induced mutants in seed cotton yield and fibre quality characters in cotton

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ABSTRACT : An investigation was undertaken to study genetic variability in 41 induced mutants of *desi* cotton (*Gossypium arboreum*) cvs., HD 123, HD 107 and American cotton (*Gossypium hirsutum*) cv. HS 6 with their respective controls. Observations were recorded on seed cotton yield and fibre quality parameters of the mutant genotypes. The seed cotton yield was maximum in HD 123-M1 (112.03 g), HD 107-M21 (146.47 g), HS 6-M (110.36 g), ginning out turn in HD 123-M2 (41.42%), HD 107-M15 (40.62%), 2.5 per cent span length in HD 107-M8 (17.70 mm), micronaire value in HD 107-M24 (7.00) and tenacity in HS 6-M (18.10 g /tex), HD 107-M8 (13.20 g/tex). Due to the induction of gamma rays and EMS the varieties showed better performance in their yield and fibre quality characteristics.

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Method for collecting leaf impression of cotton (*Gossypium hirsutum*)

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ABSTRACT : A number of workers have reported different procedures for recording morphological observations of leaves in different crops but these are time consuming and destructive. Morphological features particularly of leaf are important characteristics which frequently govern the physiological properties of the crop. The method developed by us is quick, non-destructive and everlasting. Physiological observations such as stomatal conductance, leaf temperature, RWC, transpiration can be taken immediately after collective the samples.

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Effect of management practices on productivity of late planted hybrid cotton under irrigation

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ABSTRACT : A field experiment was carried out at Regional Agricultural Research Station, Raichur to evaluate suitable management practices for late planted irrigated cotton. The agronomic management practices *viz.,* plant populations and growth promoters and nutrient sprays were explored. The pooled data revealed that cotton did not respond to 33 per cent higher population tested. All the growth regulators and nutrient foliar sprays, except triacontinol and DAP, significantly increased the seed cotton yield. Among various sprays, the maximum seed cotton yield of 1289 kg ha^{-1} was obtained with spraying of NAA @ 10 ppm + DAP @ 2.0 per cent which in turn was on par with cytozyme @ 450 ml ha^{-1} + DAP @ 2.0 percent (1252 kg ha^{-1}) and NAA @ 10 ppm (1200 kg ha^{-1}). Similar trend was observed with respect to growth and yield attributes, boll setting per centage, net returns and benefit : cost ratio. Interaction effects showed that higher seed cotton yield, net returns and benefit : cost ratio could be obtained by adopting normal population (18,518 plants ha^{-1} with 90 x 60 cm spacing) with the foliar spray of NAA + DAP at 45, 60 and 75 days after sowing under late planted conditions.

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Studies on integrated nutrient management in irrigated hybrid cotton

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ABSTRACT : A field experiment was carried out at Regional Agricultural Research Station, Raichur, during 2000-01 and 2001-02 to study the effect of integrated nutrient management on growth and yield of irrigated hybrid cotton. The pooled results revealed that sunnhemp (1513 kg ha^{-1}) and lucerne (1435 kg ha^{-1}) green manuring recorded significantly higher seed yield over no green manuring (1285 kg ha^{-1}). Among organic manures, application of FYM @ 10 tha^{-1} recorded significantly higher seed cotton yield

(1512 kg ha^{-1}) than cotton stalks @ 5 t ha^{-1} (1406 kg ha^{-1}) and no organics (1317 kg ha^{-1}). Application of 100 per cent RDF resulted in significantly higher seed cotton yield (1549 kg ha^{-1}) compared to 50 and 75 per cent RDF. Though interaction effects were not found, combination of sunnhemp + FYM + 100% RDF recorded 29.5 per cent higher seed cotton yield and 24.9 per cent higher net returns over RDF alone (1369 kg ha^{-1} and Rs.18,780 ha^{-1}). This combination also resulted in higher net returns.

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Effect of nutrients on productivity of seed cotton yield and other ancillary parameters in American cotton

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ABSTRACT : A field experiment was conducted at Punjab Agricultural University-Regional Station Faridkot, during *kharif,* 2003 and 2004 seasons. The main objective was to evaluate the effect of nutrients on seed cotton yield and quality parameters in American cotton. The experiment comprised of three American cotton varieties (F 1946, F 1861 and LH 1556) assigned to main plots and five nutrient combinations (Control, Recommended NP, Recommended NPK, Recommended NPKS, and Recommended NPKSZn i.e. 75 kg N, 30 kg P_2O_5, 50 kg K_2O and 25 kg of $ZnSO_4$ per hectare) were kept in sub plots of split plot design. The soil of the experimental site was sandy loam with neutral reaction (pH 8.0), low in organic carbon (0.39%) and available phosphorus (12 kg/ha) but high in potassium (385 kg/ha). The data were recorded for plant height (cm), bolls per plant, boll weight (g), seed cotton yield (kg/ha), ginning outurn (%), lint index and seed index. The yield results indicated that among the varieties tested, significantly the highest seed cotton yield was observed in case of F 1946 as compared to F 1861 and LH 1556 during both the years of experimentation. The pooled data over the two years indicated that the variety F 1946 recorded 8.6 and 19.0 per cent higher seed cotton yield over F 1861 and LH 1556, respectively. Similarly on pooled basis, F 1861 also recorded 9.5 per cent significantly higher seed cotton yield over the variety LH 1556. Among various nutrient combinations, it was observed that there was an increase in plant height, no. of bolls per plant and seed cotton yield with increased nutrient combinations. However, combined application of Recommended dose of NPK gave equivalent yield as that of with Recommended dose of NPKS and NPKSZn but significantly higher seed cotton yield over that in Control and NP alone during both the years. Pooled data also indicated significantly higher seed cotton yield with application of recommended NPK over that in Control and NP alone. Application of sulphur and zinc nutrients in addition to recommended NPK could not influence seed cotton yield significantly. Except for seed index and lint index and that too during 2003 only, nutrient combinations did not influence boll weight and quality indices *viz.*, ginning outturn, lint index and seed index. All interaction effects were found non significant.

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Efficacy of trifloxysulfuron sodium 75 per cent WG on weed control of cotton

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ABSTRACT : An experiment was conducted on medium deep black soil at Cotton Improvement Project, Pahatma Phule Krishi Vidyapeeth, Rahuri to evaluate the efficacy of Trifloxysulfuron sodium 75 per cent WG on cotton weed control during 2001-02, 2002-03 and 2003-04 seasons. The experiment was laid out in randomized block design with 7 treatments, replicated four times with hybrid NHH 44. The results indicated that the treatment T-2 (2 weedings + 2 hoeings) recorded the highest seed cotton yield (1330 kg/ha) which was significantly higher than rest of the treatments but was on a par with T-7 (Trifloxysulfuron sodium 75 per cent WG @ 10.0 g a.i./ha). Similarly, treatment T-7 (1239 kg/ha) and treatment T-3 (Paraquat 24 WSC 1250 m/ha) were *on a par* with each other. Treatment T-7 recorded the lowest weed biomass (1111 kg/ha) and highest weed control efficiency (46.79%).

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Effect of crop geometry and integrated nutrient management on fibre quality and nutrient uptake by cotton crop

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ABSTRACT : A field experiment was conducted during *kharif* season of 2003 at Cotton Research Station, Sirsa of CCS HAU, Hisar. The experiment consisting of crop geometry (67.5 x 30 cm, 101.25 x 30 cm and 101.25 x 20 cm) in main plots and fertilizer levels (control, vermicompost @ 5 t ha^{-1}, $N_{20}+P_{15}$+vermicompost @ 3.75 t ha^{-1}, $N_{40}+P_{15}$+vermicompost @ 2.5 t ha^{-1}, $N_{80}+P_{30}$ (recommended) and $N_{80}+P_{30}$+vermicompost @ 1.25 t ha^{-1}) in sub plots, was laid out in split plot design. Ginning out turn, lint index, fibre length, fibre strength, fibre fineness and fibre maturity were not influenced by crop geometry, except seed index which was higher in broader crop geometry (101.25 x 30 cm). Fertilizer application had no significant effect on ginning out turn, fibre strength, fibre fineness and fibre maturity. However, lint index, seed index and fibre length were imprved with the higher level of fertilizer alone or in combination with vermicompost. Nitrogen and phosphorus uptake in plant and seed increased with the application of fertilizer.

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Agronomic evaluation of *Bt* cotton hybrids in summer irrigated tract of southern Tamil Nadu

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ABSTRACT : Yield potential of two *Bt* hybrids *viz.*, MECH 162 and MECH 184 was determined at three levels of fertilizers and two levels of spacing at TANU, Cotton Research Station, Srivilliputtur during summer 2005. MECH 162 *Bt* registered the tallest plants and was significantly higher than MECH 184 *Bt* and RCH 2 non *Bt* spacing did not influence the plant height. Application of 120 : 60 : 60 NPK/ha recorded the tallest plants. Spacing and fertilizer levels did not influence the number of monopods/plant. RCH 2 recorded the highest number of sympodia/plant. MECH 162 *Bt* recorded the highest number of bolls. The spacing did not influence the boll weight.

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Global status of insecticide resistance in *Helicoverpa armigera* on cotton

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ABSTRACT : Current status of *Helicoverpa armigera* resistance against the insecticides used in cotton need to be reviewed so that furture management strategies could be modified accordingly. *H. armigera* has generally been considered relatively susceptible to organophos phates.Monitoring for organophosphates resistance was carried out in *H. armigera* from different cotton growing districts for the period 1995-1999. Significant resistane to methomyl was recorded in straints of *H. armigera* from shandong province. High level of resistance (i.e. 52-148 fold) to carbaryl was recorded in two strains collected from Jabalpur and Bhopal districts. Resistance to endosulfan in *H. armigera* has been recorded in Australia since early 1970's and a number of report have demonstrated the substantial and continuing nature of this problem. In India, relatively two levels of resistance were characteristic of *H. armigera* in various regions of India from 1988 to 1992. Bioassay was conducted on *H. armigera* population collected in Australia from 1977 to 1983. In Pakistan, *H. armigera* developed 26-168 fold resistance to cypermethrin as compared to susceptiable laboratory strain. Continuous monitoring and evaluation of *H. armigera* population showed low level of resistance during 1988-1989 in Andhra Pradesh. In Punjab, higy level of resistance was observed to cypermethrin (i.e. 59.86 fold).

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Field evaluation of flubendiamide (NNI 0001 480 SC) against bollworms complex on upland cotton

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ABSTRACT : A new insecticide, flubendiamide (NNI 0001 480 SC), was evaluated against bollworms compex of cotton in three experiments during 2004 and 2005 crop seasons. The mean per cent bollworms incidence in intact and shed fruiting bodies varied from 1.10 to 2.09 and 3.21 to 5.37 per cent, respectively in flubendiamide and was significantly lower than endosulfan and quinalphos. The mean damage in pickable bolls and locule varied from 3.65 to 7.05 and 1.70 to 3.98 per cent, respectively in flubendiamide and was significantly lower than in standards. The mean seed cotton yield was significantly higher in flubendiamide @ 60 g a.i./ha, followed by its lower doses of 48 and 36 g a.i./ha. It was significantly lower in endosulfan and quinalphos than flubendiamide. On the basis of bollworms incidence and yield, flubendiamide @ 48 g a.i./ha was found to be the optimum dose.

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Evaluation of spinosad 45 SC (Spinosyn A 50% Minimum and Spinosyn D 50% Maximum) against bollworms complex in cotton

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ABSTRACT : Efficacy of Spinosad 45 SC (Spinosyn A 50% Minimum and Spinosyn D 50% Maximum), a new formulation from DeNocil India Limited, was evaluated alongwith commercial Spinosad (Tracer 45 SC), indoxacarb, chlorpyriphos and cypermethrin during *kharif* 2004 and 2005. Spinosad (Spinosyn A 50% Minimum and Spinosyn D 50% Maximum) @ 100, 75 and 50 g a.i. resulted in lowest incidence of bollworms in intact and shed fruiting bodies and was significantly better than chlorpyriphos and cypermethrin and on par with Tracer and indoxacarb. On the basis of damage in pickable bolls, the loest damage was recorded in Spinosad (Spinosyn A 50% Minimum and Spinosyn D 50% Maximum) @ 100 g a.i./ha i.e. 2.85 and 1.36 per cent on boll and loculi basis, respectively, which was on par with its respective lower dosages, Tracer and indoxacarb and significantly lower than chlorpyriphos, cypermethrin and control. The maximum seed cotton yield (24.44 q/ha) was also recorded in Spinosad 45 SC (Spinosyn A 50% Minimum and Spinosyn D 50% Maximum) @ 100 g a.i./ha. No resurgence of sucking pests was observed with this insecticide. Thus, Spinosad 45 SC (Spinosyn A 50% Minimum and Spinosyn D 50% Maximum) @ 100 g a.i./ha proved effective for the management of bollworms.

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Distribution pattern of American bollworm, *Helicoverpa armigera* Hubner, in *hirsutum* cotton

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ABSTRACT : Spatial distribution of American bollworm, *Helicoverpa armigera* Hubner, was studied for several weeks on cotton cv. MCU-5 during *kharif,* 2001 and 2002 using various distribution parameters like variance mean ratio, dispersion parameter (K), Lloyd's Index of mean crowding, patchiness index, Taylor's power low and Chi-square test (X^2). The pest followed mostly aggregated or contagious pattern of distribution and negative binomial model was found to be good fit in the observed data.

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Duration, survival and mortality factors of *Helicoverpa armigera* (Hubner) larvae in cotton ecosystem in Haryana

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ABSTRACT : Two years (2003 & 2004) studies on survival, mortality factors and duration of *Helicoverpa armigera* (Hubner) (Lepidoptera : Noctuidae) larvae were conducted during 2003 and 2004 at the Research Farm of Department of Entomology, CCS Haryana Agricultural University, Hisar. The neonate larvae were released on different dates on cotton (var. H-1098) plants in the field under exposed and caged conditions and observations on their survival were recorded at different intervals. Mean larval duration during September-October, October and November was 17.5, 22.7 and 26.4 days in 2003, and 15.0, 22.6 and 30.1 days in 2004, respectively. Overall mean larval loss during September to November in the two years within six days of release of larvae on the crop was 50.67 (28-100) per cent under exposed conditions, and 30.67 (4-56) per cent under caged conditions. The rate of larval loss was quite slow in the older larvae. Larvae released on the crop on 9 and 19 June, 2004, when maximum temperature was between 34.7 and 39.2°C and relative humidity between 25 and 56 per cent, did not survive for more than 24 hours. No larval parasitization was found during both the years. Larval mortality due to NPV infection during August to November was 5.2 to 24.6 per cent in 2003, and 6.6 to 10.0 per cent in 2004, being maximum in October. A few larvae were observed to be predated upon by *Vespa orientalis.* It was concluded that the important larval mortality factors for this pest were dispersal/dislodgement from plants and some unknown reasons in the early instars, and NPV infection, predation and unknown reasons in the late instars.

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Efficacy of thiamethoxam as seed dresser against sucking pest of cotton

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ABSTRACT : To evaluate the bio-efficacy of thianicotynyls as seed dressers, an experiment was conducted alongwith standard check against sap sucking pests of *hirsutum* cotton hybrid JKHy-1 during 1999-2000 and 2000-2001 at AICCIP, Khandwa. The seed dressing insecticides *viz.* imidacloprid 600 FS @ 5, 9, 12 ml/kg and imidacloprid 70 WS @ 7.5 g/kg seed, Thiamethoxam 70 WS @ 2.8, 4.28 g/kg and standard check carbosulfan 25 DS @ 50 g/kg kept the population of jassid and aphid below ETL up to 40 days after germination. All seed dressing insecticides recorded significantly higher seed cotton yield than standard check and untreated control. Maximum net profit (Rs.4465.12/ha) was gained from plot treated with imidacloprid 600FS @ 12 ml/kg seed. It also enhanced the growth of cotton plants.

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Bio-control agents and their role in regulation of cotton bollworms population

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ABSTRACT : The bio-control agents of bollworms in cotton ecosystem comprised predatory wasp (*Delta* sp.), pentatomid bug (*Cantheconidea furcellata*), spiders (*Oxyopes* sp. and *Argeope* sp.), green lacewing (*Chrysoperla carnea*), coccinellid (*Menochilus sexmaculatus*) and parasitoids *viz.*, *Trichogramma chilonis* and *Rogadinae* sp. Maximum activity of predators was recorded during October 2nd week (41st standard week) or 4th week (43rd std. week) which was two to four weeks prior to the bollworm larvae reaching their peak. The egg parasitoid, *T. chilonis,* occurred from the first fortnight of August to end of November and on an average parasitized 22.18 and 15.87 per cent eggs of *Earias vittella* and *Helicoverpa armigera,*

respectively. The braconid larval parasitoid, *Rogadinae* sp., being recorded for the first time in cotton, parasitized 1.5 to 28.5 per cent late instar larvae of *E. vittella* during the peak activity of the pest.

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Influence of agroclimatic situations on the incidence of Myrothecium leaf blight of cotton incited by *Myrothecium roridum*

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ABSTRACT : Based on two years (2002-03) studies, the differences in the expression of Myrothecium blight in various situations were significantly high, with maximum expression of the disease in deep soil + high rainfall situation. During both the seasons individually and also on pooled basis, the incidence was higher in high rainfall situation, irrespective of the soil type in which the cotton crop was grown indicating that high moisture played an important role in the development of this disease.

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Histopathological studies on cotton leaf curl susceptible and resistant cultivars

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ABSTRACT : Cotton leaf curl disease (CLCuD) is a major threat to *Gossypium hirustum* cultivation and is one of the important factors responsible for the sharp decline in area and production of American cotton in Northern India. The histopathological studies of the virus infected plants can play an important role in detecting the latent infection in the infected plants. Studies on comparative histopathological changes in CLCuD susceptible and resistant varieties showed that significant ultrastructural changes in the susceptible host tissue occur only at 45 days after inoculation with respect to cuticle, epidermis, palisade cells and spongy parenchyma. Such changes were absent in the host tissue of the resistant cultivar, LHH 144. A complete or partial collapse of the vascular tissues and enlargement of air spaces in the spongy parenchyma were also observed due to this disease in the leaves of the susceptible varieties.

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Epidemiological studies on bacterial blight of cotton caused by *Xanthomonas axonopodis* pv *malvacearum*

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ABSTRACT : The present work was intiated to study the progress of the bacterial blight of cotton caused by *Xanthomonas axonopidis* pv *malvacearum* (Smith) in relation to the environmental factors under different dates of sowing and spacings. The investigation revealed that the bacterial leaf blight appeared to a level of 8.6 per cent in 38th standard week i.e. during September, 2002 in normal sown plots (July 5, 2002) and 10.2 per cent in 37th standard week in delayed sown plots (July 20, 2002). The bacterial leaf blight disease increased progressively and reached its maximum (31.6%) during second week on November in normal sown plots and 32.2 per cent in 44th standard week in delayed sown plot. It is clear that bacterial leaf blight incidence was maximum in normal sown plot with a spacing of 90 cm in between rows and 30 cm between plants with in a row than delayed sown plot with closer spacing (60 cm x 30 cm). Bacterial leaf blight appeared one week before in delayed sown plot than in normal sown plot. Wind speed exhibited strong negative association with the spread of the disease incidence in both situations *viz.,* normal sowing and delayed sowing. However, in normal sowing maximum temperature exhibited strong negative association with the disease. The increase in the morning relative humidity at normal

sowing and rainfall and sunshine hours in delayed sowing were found to be associated with increase in disease.

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Assessment of losses due to leaf curl virus (CLCuV) disease in cotton (*Gossypium hirsutum*)

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ABSTRACT : The present study was carried out on the extent of losses caused by CLCuV disease. The results revealed that the maximum reduction in plant height, number of bolls/plant, average boll weight and seed cotton yield were found to the tune of 43.00, 61.54, 38.85 and 68.30 per cent respectively in disease grade-4 plants in comparison to healthy plants (grade-0). The disease also deteriorated the quality and fibre characters. Reduction percentage of 9.75, 20.45, 27.26, 9.96, 15.38, 16.98 and 10.89 were estimated in G. O. T. seed index, lint index, span length, uniformity ratio, micronaire value and strength respectively. Among the different grades of disease significant reduction recorded in germination, dry weight, seedling length and vigour index. All the biochemical parameters were decreased with the increase in age of plant. The susceptible variety HS 6 possessed high total sugar and protein whereas, low total phenols and tannin contents as compared to resistant variety (H 1226). Total phenols and tannins were increased while total sugars and proteins decreased with increase in severity of the disease.

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Influence of weather variables on cotton leaf curl virus (CLCuV) disease in cotton (*Gossypium hirsutum*)

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ABSTRACT : Whitefly (*Bemicia tabaci*) transmitted cotton leaf curl virus disease (CLCuV) has been recognized as the major problem in cotton cultivation. For the management of any disease, it is important to study the quantitative relationship among the weather variables, vector population and disease incidence. To find out the correlation among the disease incidence with weather parameters and vector population, an experiment was carried out for two years using susceptible cultivar HS 6 at Cotton Research Area, CCS Haryana Agricultural University, Hisar. The role of weather variables on whitefly population build up and incidence of CLCuV have been investigated separately and in combination. The disesese incidence had significant but negative correlation with relative humidity (morning, evening and mean) and maximum temperature. A strong positive correlation was found between whitefly population and disease incidence. However, significant correlation could not be established among different weather parameter and whitefly population individually. A significant multiple correlation existed among all weather parameters and individually with disease incidence and the whitefly population.

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Adoption of cotton IPM technology in Eastern Nimar of Madhya Pradesh – a survey

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ABSTRACT : A field survey was conducted in the year of 2002-03 and 2003-04 to find out the constraints in adoption of IPM technology and suggestions made by farmers. The findings of the study revealed that the socioeconomic status of farmers played a crucial role in adoption of IPM technology. Out of the five top ranked constraints felt by the farmers, three constraints *viz.,* influence of fellow farmers (70.84%), tendency to pursue credits facility (67.71%) and unawareness about latest technology of IPM (65.83%), fell under this category. Farmers expressed more faith in their fellow farmers than to the other

agencies. Farmers' tendency to pursue credit facility as extended by the pesticides-dealers compelled the farmers to consider market-oriented, technologically poor suggestions offered by the dealers. The farmers were found to be mostly unaware of the latest IPM technology due lack of proper communication. To improve upon the situation, majority of the farmers (68.02%) felt that the regular training programmes should be organized to explain the latest technology of IPM. Government should have control on the supply, prices and quality of IPM inputs. The Government may also increase and strengthen the credit facility for the farmers (59.8%).

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Evaluation of *Bt* cotton for yield and cost-effectiveness at farmers fields

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ABSTRACT : Bollgard hybrid MECH 12 *Bt* recorded higher yield than MECH 184 *Bt*. The overall average yields of MECH 12 *Bt* and MECH 184 were 1231 kg/acre and 1188 kg/acre as against 1149 kg/acre and 1117 kg/acre of checks, respectively. There was a spraying of 3.8 sprays for the control of bollworms in bollgard cotton than the checks. The net returns of MECH 12 and MECH 184 *Bt* cotton hybrids were Rs.4816/acre and Rs.4146/acre, respectively. Bollgard farmers realized higher Cost Benefit Ratio than checks.

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Screening of cotton genotypes against stem weevil, *Pempherulus affinis* Faust in field conditions

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ABSTRACT : A total of 428 entries were tested for four years against stem weevil and only 11 entries *viz.,* CPD 743, NDLH 1650, G. Cot 18, RACH 16, ADT1, PSLV 11, Ajeet 11, SVPR 2, GSHV 97/13, CPD 755 and SCS 59 were found resistant.

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Epidemiological studies of Alternaria leaf spot (*Alternaria macrospora* Zimm) in cotton

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ABSTRACT : Alternaria leaf spot of cotton caused by *Alternaria macrospora* Zimm is an important foliar disease and causes severe loss in seed cotton yield. The present investigation revealed that the Alternaria leaf spot of cotton started with 0.7 per cent disease index in the first week of October and it increased progressively and reached upto 44.40 per cent disease index in the 1st week of December. The correlation studies revealed that there was a significant and positive correlation between per cent disease incidence and the following factors : morning relative humidity, morning relative humidity before one week, morning relative humidity before two weeks and rainfall before two weeks. From the full model regression equation it was found that the coefficient of determination (R2) was found to be 0.94447 which implied that 94.47 per cent of the variation in the disease development was accounted for maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and rainfall of current week and past one week and past two weeks.

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Effect of herbicides on *Trichoderma harzianum*

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ABSTRACT : Herbicides were evaluated under *in vitro* conditions against *Trichoderma harzianum.* Alachlor was found to be the most inhibitory at the lowest concentration. Klass was found least inhibitory. Pendimethalin was effective at higher concentrations. Overall, Alachlor (100.00%), followed by Paraquat (84.58%), Glyophosate (73.81%) and Pendimethalin (63.73%) were found suppressive for the growth of *T. harzianum.*

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Efficacy of different inoculation techniques for Rhizoctonia root rot in cotton

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ABSTRACT : Among the three inoculation techniques for *Rhizoctonia* root rot tested during *kharif* 2003 and 2004 under artifical conditions of inoculation, soil application technique gave the maximum plant mortality (85.8% and 89.3%) in varieties F 846 and RG 8, respectively. Soil application technique of *Rhizoctonia solani* and *R. bataticola* was the most efficient method of artificial inoculation of the pathogens for its further mass multiplication, meant for using inoculum of these fungi on a large scale in the field, to induce maximum disease under artificial condition of inoculation.

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Screening of diploid cotton (*Gossypium arboreum*) genotypes against major diseases

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ABSTRACT : Twenty nine genotypes were screened against major cotton diseases. Only one germplasm line, namely, HD 2582, was found resistant to bacterial leaf blight having first grade of disease symptoms. Elevens germplasm lines, namely, PAIG 127, GLA 794, MDL 2463, GISV 570, DLSA 201, CAM 216, AKA 9409, HD 424, KWA 135, GM 184 and PM 407 were found moderately resistant. Jawahar Tapti, HD 424 and GISV 570 showed high resistant reaction against Myrothecium leaf blight. Twelve germplasm lines, namely, PAIG 127, GLA 794, MDL 2463, CAD 127, RG 284, MDL 2582, DLSA 201, CAN 216, GAM 107, KWA 135, RAS 1 and KWA 24 were found moderately resistant to Myrothecium leaf blight. Genotypes PA 407, CAD 129, GM 187 and AKA 9629 were found free from new wilt. So, these resistant germplasm / genotypes could be further used in breeding programmes.

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Evaluation of insecticides against *Sclerotium rolfsii* of cotton

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ABSTRACT : Five insecticides were tested at six concentrations (50, 100, 200, 250, 500 and 750 ppm) on *a.i.* basis against *Sclerotium rolfsii* by poisoned food technique. Chlorpyriphos recorded the highest inhibition (77.48%), followed by imidacloprid (56.63%). Carbofuran, phorate and endosulfan had the mean per cent inhibition of 37.06, 28.69 and 10.87, respectively.

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Elite sources of resistance against cotton leaf curl disease in upland cotton

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ABSTRACT : Experiments were conducted during *kharif* 2002 and 2003 at Punjab Agricultural University, Regional Station, Faridkot (Punjab) India, to find the resistant entries against cotton leaf curl disease (CLCuD) under natural epiphytotic conditions. The pooled data of the two years showed that out of 783 entries, 17, namely, Dafatri 29, F 1976, F 2020, F 2032, F 2036, F 2062, F 2067, F 2070, F 2077, FHH 99, K 888, LHH 144, LHH 935, LHH 1128, Mahabeej 117, RS 2283 and RS 2315 were free from the CLCuD and categorized as highly resistant. Two entries, F 1861 and LH 1961, were found resistant with first grade of disease symptom. It was suggested that these entries could be further used in breeding programme in order to develp disease resistant varieties of upland cotton (*Gossypium hirsutum*).

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Effects of cotton hybrids and farm sizes on economics of cotton production under rainfed condition

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ABSTRACT : Investigation was carried out during 2003-04 on small, medium and large size farms to study the effects of three cotton hybrids (i.e. NCS 145, JKCH 666 and NHH) on yield, cost and returns in cotton production under rainfed condition on farmers' fields in Marathwada region of Maharashtra. Results revealed that NCS 145 recorded seed cotton of 11.73 q/ha, cotton stalk of 13.66 q/ha, return from seed cotton of Rs. 28738.50/ha, return from cotton stalk of Rs.682.83/ha, gross returns of of Rs.29421.33/ha, farm business income of Rs.16744.78/ha, family labour income of Rs. 16622.11/ha and net profit of Rs. 9823.44/ha. All aspects were statistically higher than that of JKCH 66 and NHH 44 at 5 per cent level of significance. Irrespective of cotton hybrids, results showed that small cotton farm recorded seed cotton of 12.00 q/ha, cotton stalk of 14.05 q/ha, return from seed cotton of Rs.25884.00/ha, returns from cotton stalk of Rs.702.33/ha, gross return of Rs. 29586.33/ha, cost- 'A' of Rs. 12529.34/ha, cost-'B' of Rs. 17725.43/ha, cost-'C' of Rs. 19841.60/ha, farm business income of Rs. 17056.99/ha, family labour income of Rs. 11860.90/ha and net profit of Rs. 9744.73/ha and all the aspects were significantly higher than those on the medium and the large farms.

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Allocative efficiency of cotton based farms in Vidarbha region of Maharashtra for augmentation of income

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ABSTRACT : With spiraling cost of inputs and in efficient allocation of land, capital and labour resources to crops the net income from cotton based farms have been falling in real terms in the Vidarbha region of Maharashtra. To sustain crop activities the farmers borrow heavily falling into a debt trap. Linear programming models have been developed for small, medium and large farms to optimize and increase the resource allocation efficiency on these farms for increased net returns within the available resources. Plans were developed which could realize higher profits without the need to borrow additional capital. Cotton has been facing a threat from other crops like Soybean in these parts because of its higher cost of cultivation. However, cotton intercropped with Pigeonpea entered all the optimal plans, meaning it is still profitable to cultivate cotton in preference to other crops.