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CHAPTER 5

SUMMARY AND CONCLUSION

Cotton is the main cash crop in Egypt, Egyptian cotton is of the best long stable varieties with its economic and technical advantages. Besides, the extra-long and extra-fine recently introduced to cotton cultivars had an excellent economic demand with the maximum prices world wide. Cotton plant has green, succulent leaves many large open flowers, nectarines on every leaf and flower, a large number of green bolls. All these characters are variable for various insects attracted to cotton plants in various stages of growth, the most dangerous of these pests are bollworms, *P. gossypiella* and *E. insulana* which result in about 20% of cotton seed yield in Egypt.

Therefore, it is necessary to find out more than an IPM regime effective enough in reducing infestation by bollworms in both organic and conventional cotton to reach the highest efficacy in controlling bollworms and minimizing losses resulting from bollworm infestation, at the same time are efficient enough against cotton leafworm and sucking piercing insects and also enhancing the role of beneficial in reducing populations of cotton insects.

In order to achieve this purpose, field experiments were conducted at the Research Experimental Farm of the Faculty of Agriculture, Saba Basha, Alexandria Univ., during cotton growing seasons of 2004 and 2005 to determine the effect of 4 IPM organic regimes [Naturalytes, Biocides, Botanicals and releasing a parasitoid of *Trichogramma* spp.] and 6 IPM regimes in conventional Cotton [O.P., oxime carbamate, S. pyrethroids, a naturalyte, Spinosad and their mixtures with safe materials at half a rate of each compound] on bollworms as target pests and on CLW and sucking pests as non-target insects. Also, the effect of foliar treatments, Greenzit, Ascorbic acid and salicylic acid and deflowering at the flowering stage on the populations of these insects on early and late organic and conventional Grown cotton at higher plant density (60 cm apart between rows, 20 cm a part between tuelles) except for Prog. 4 in organic cotton and Prog. 11 in conventional Cotton which their plants were grown at lower plant density (70 cm apart between rows and 25 cm apart between hills) and had the same treatments of Prog. 3 and 10, respectively.

1. Effect of foliar treatments and deflowering applied at the beginning of flowering stage on the infestation levels by PBW in 2004 and 2005 cotton seasons.

The most abundance of PBW was detected in the last week of July and the first week of August. Earlier grown cotton gave significantly lower infestation levels by PBW in both organic and conventional Cotton. All IPM regimes of organic and conventional cotton. All IPM regimes of organic and conventional cotton reduced significantly the infestation by PBW than the untreated check in both early and late, organic and conventional cotton.

The average percentage of reduction of PBW in both seasons 2004 and 2005 during flowering period in organic cotton was highest (50.4) in Prog. 4 which its plants were grown at lower plant density and treated with ($1/2$ g/l of each Ascorbic and Salicylic acid), while this average was 41.9% in Prog. 3 which had the same treatment but its plants were grown at higher plant density, Prog. 2 reduced PBW population [Ascorbic acid at 1 g/l. While in conventional cotton, the lowest average % reduction of PBW in both early and late cotton 33.45% was calculation in regime 6, Greenzit at 0.2 g/l and increased to 39.8% and 46.9% when S.A at 1 g/l and AA at 1 g/l were sprayed after spraying Greenzit at 0.2 g/l in regimes 7 and 8, respectively

Therefore Ascorbic acid is more efficient than salicylic acid in reducing incidence of PBW. While the treatment of Prog. 9, Greenzit at 0.2 g/l, followed by $1/2$ g/l of each Salicylic and ascorbic acid was the most effective foliar treatment in reducing the population of PBW amounted to 53.95% average reduction percent of both seasons 2004 and 2005 early and late, conventional cotton. While the highest reduction 66.45% of PBW/25 flowers, square, or young bolls was given by regime, 11 (Deflowering at lower plant density) and was comparable to 54.25% in Prog. 10 (deflowering at higher plant density). Earlier grown cotton gave significantly lower levels of infestation by PBW 1.63, 1.59 larvae/25 squares, flowers or young bolls than latter grown cotton 2.09, 3.03 in both organic and conventional cotton.

2. Effect of treatments of IPM regimes on infestation levels by PBW in both seasons of 2004 and 2005 during boll formation period.

(1) In organic cotton: regime 4 was most efficient in reducing population of PBW in green bolls resulting in 80.55% average reduction % in both seasons of 2004 and 2005 in early and late organic cotton grown at lower plant density. Releasing *Trichogramma*, Agerin + Achook 1g, 1 ml/l, Agerin+ Achook 1g, 1 ml/l + *Trichogramma*, Spinosad + Meenark, Dipel 1g g/l + 5g/L Meenark) at lower plant density Prog. 4 which exceeded Prog. 2 and 1 induced 79.1% and 74.23% reduction PBW population, respectively. *Trichogramma*, Agerin or Achook each alone did not give good control of PBW, while any combination of both of them or all of them enhanced the performance against PBW. Also, cotton seed oil and Meenark enhanced the performance of Spinosad in reducing the population of PBW. PBW tend to be more abundant in higher plant density and in latter grown cotton. In conventional cotton, Greenzit_{SP100} was effective enough to reduce infestation of PBW by 33.5% which increased to 39.8% by adding 1 g/l Salicylic acid and more increased to 39.8% when Ascorbic acid is added at 1 g/l in Prog. 8 and was much increased to 54% $1/2$ when $1/2$ g/l Ascorbic and Salicylic acid were added to 0.2 g/l, Greenzit_{SP100}, which the highest % reduction 66.45% occurred in Prog. 11 deflowering at lower plant density.

Prog. 11 showed the least infestation level 1.15, 1.36 larvae/25 green bolls in 2004 and 2005 followed by Prog. 10, 1.36, 1.39 followed by Prog. 9 1.53, 1.64 larvae/25 green boll. i.e [Curacron + Match, P + C.S.O, Spinosad + KZ oil, Larvin + Larvin] at lower plant density was most affective against PBW, followed by the same prog at higher plant density (Prog. 10), and came next Prog. 9 [Curacron+

Achook, Karate + Spinosad, Spinosad + Achook, Larvin + KZ oil], which caused 86.9, 85.6 and 83.4% average [percentages reduction of PBW larvae in both seasons, while the treatment of single chemical insecticides (regime 6) resulted in the least percent reduction of 75.9%.

3. *Earias insulana* during flowering period as affected by foliar treatments and deflowering

Prog. 3 gave the least infestation level/25 squares or flowers in both seasons 1.3 and 1.38 followed by 1.63, 1.7 in Prog. 2 in both seasons 2004 and 2005, respectively, while the highest 1.93, 2.02 were given in Prog. 1, the highest abundance of SBW in this period was recorded in the last week of July and 1st week of August. Earlier grown cotton showed significantly lower infestation level by SBW than later grown cotton 2.93 versus 3.02. The highest abundance 3.85 and 2.8 larvae/25 flowers or squares in both organic and conventional cotton in the last week of July and first week of August Ascorbic acid was more effective than Salicylic acid in reducing SBW infestation as an average % of SBW reduction in both seasons of 2004 and 2005 in organic cotton 30.4% and 41.4%, respectively, while the treatment of half a dose of each in Prog. 3 and 4 was more efficient resulting in 52.5% reduction in Prog. 3 (higher plant density) which was much more than 32.88 in Prog. 4. While in conventional cotton, Greenzit_{SP100} at 0.2 g/l was efficient enough in reducing SBW incidence by 31.4% in regime 6 and its efficacy increased when spraying Salicylic acid at 1 g/l regime 7, resulting in 38% reduction and the average % reduction in SBW was more increased by spraying 1 g/l Ascorbic acid regime 8 after spraying 0.2 g/l Greenzit_{SP100} at 0.2 g/l and reached 43.5% reduction. While, the treatment of 0.2 g/l Greenzit_{SP100} followed by 0.5 g/l Ascorbic acid and 0.5 g/l Salicylic acid of Prog. 9 was the most efficient foliar treatment achieving average reduction of SBW to 51.1% as an average % of 2004 and 2005 cotton seasons, followed by 48.7% in Prog. 10 (deflowering at higher plant density which was higher than 36% of Prog. 11 (deflowering at lower plant density).

4. Effect of IPM regimes on the incidence of SBW during boll formation throughout both seasons of 2004 and 2005.

In organic cotton, the least infestation level 2.1, 1.96 in both seasons, respectively, were given Prog. 3 which induced an average % reduction of SBW larvae by 76% as an average of 2004 and 2005 cotton seasons in higher plant density versus 72.5% of Prog. 4 in lower plant density [1 G/L Agerin + 1 ml/l Achook, Agerin+ Achook + releasing *Trichogramma*, Spinosad at 50 ml/ fadd, Dipel at 2 g/l], while Prog. 2 and 1 resulted in 73.3% and 71.3% reduction, respectively. *Trichogramma* alone was not efficient in reducing SBW and not give good control of PBW, but it maintained the level of infestation below ETL, also when released after spraying Agerin or/and Achook at half a rate each was efficient in reducing SBW and PBW populations in both seasons of 2004 and 2005. Performance of Tracer was enhanced by mixing cotton seed oil in Prog. 2 and Meenark (fish oil rosin soap) in Prog. 3 and 4, also when Meenark was added to Dipel.

Despite *Trichoderma* did not give good control of bollworms, it maintained infestation level below ET and was more effective against PBW than SBW and its efficacy increased by combining Agerin or Achook or both at half a rate. The efficacy of each single chemical insecticide was significantly increased when combined at half a rate with half a rate of safe compound. The abundance of both bollworms was significantly more at the end of the season, the last week of Sept. (in earlier grown cotton) and the first week of October (in latter grown cotton). Earlier grown cotton gave significantly lower levels of infestation by bollworms than latter grown cotton. PBW was more abundant in higher plant density on contrast of SBW which was more abundant in lower plant density. Deflowering was more effective in reducing PBW population at lower plant density, while the foliar treatment of 0.2 g/l Greenzit_{SP100}, 0.5 g/l Ascorbic acid in Prog. 9 had the same efficacy on SBW in higher plant density as deflowering.

In conventional cotton, regime 6 of insecticides alone showed the highest infestation 2.28 and 2.53 in 2004 and 2005 seasons, respectively and gave an average reduction of 72.9%, while mixtures of insecticides on the basis of difference of mode of action of both combined compounds at half a rate each reduced significantly infestation levels to 2.11 at regime 7, 1.9, 2.03 in regime 8 and 1.85, 1.88 in regime 9 and 1.75, 1.74 in regime 10, while incidence of SBW was more in regime 11, 1.88 and 1.94 (lower plant density). Regime 10 induced the highest average % reduction of SBW 80.3% in both season, followed by 79% in regime 9, 78.5% in regime 11 followed by 77.8% and 76% in regimes 8 and 7, respectively. Earlier grown cotton showed less infestation levels 2.6 larvae/25 bolls than latter grown cotton 2.9. The most abundance of SBW 1.5, 3.63 was detected in the last week of Sept., and 1st week of October in 2004 and 2005 seasons.

Side effect of foliar treatments of IPM regimes applied at the beginning of flowering period on the incidence of some piercing sucking pests during of flowering period.

Organic cotton was sprayed with liquid potassium soap produced from cotton seed oil at 1 L/fed. then sprayed with foliar treatments salicylic acid at 1 g/l in Prog. 1 and Ascorbic acid at 1 g/l in Prog. 2 and 0.5 of each salicylic acid and Ascorbic acid in both regimes 3 (higher plant density) and 4 (lower plant density). While conventional cotton, was sprayed with Romectin (Abamectin) at 5 ml/10 L, in regimes 6, 7, 8 and 9 were treated with 0.2 g/l Greenzit_{SP100}, followed with 1 g/l Salicylic acid in Prog. 7, 1 g/l Ascorbic acid in Prog. 8, 0.5 g/l of each Salicylic and Ascorbic acid in Prog. 9. While Prog. 10 and 11 were not treated with any foliar treatments. In this period (flowering), all sucking pests were most abundant during 25th of July and 7th of August. Prog. 3 in organic cotton showed the least populations of sucking pests per 5 leaves 3.26 aphids, 3.85 jassids, 3.93 white fly and 2.63 red spider mite during 2004 and 5.44 aphid, 5.47 jassid, 4.44 white fly, 5.41 red spider mite in 2005 and were significantly lower than other IPM regimes and untreated check which showed the highest infestation levels by mentioned sucking pests while Prog. 4 showed the highest infestation of sucking pests of IPM regimes in 2004 and 2005 though, the same treatments of Prog. 3 were applied to Prog. 4 but its plants were at greater plant spacing (lower plant density) except for red spider mite which was less abundant in Prog. 4, 2.39/5 leaves. Also, the

treatment of 0.5 g/l of each Ascorbic and Salicylic acid was the best in reducing population of sucking pests in organic cotton, resulting in 74.7% reduction in population of *Aphis gossypii*, 52.9%, 47.11, 55.9% reduction in jassids, white fly and red spider mite, respectively in 2004 and inducing reduction of 60.3%, 40.6%, 48% and 46.93% in the populations of aphids, jassids, whiteflies and red spider mites, respectively in 2005 season, followed by the treatment of 1 g/l Ascorbic acid in regime 2 which exceeded the treatment of Salicylic acid 1 g/l (in regime 1) in inducing higher reduction of sucking pests in organic cotton in both seasons of 2004 and 2005. While in conventional cotton Greenzit at 0.2 g/l was effective and increased tolerance of cotton plants against sucking pests. Its efficiency was increased by adding either Salicylic acid at 1 g/l in regime 7 or by adding 1 g/l Ascorbic acid in regime 8 and was much increased in reducing populations of sucking pests by the treatment of 0.2 g/l Greenzit and 0.5 g/l Salicylic acid + 0.5 g/l Ascorbic acid in Prog. 9 which was the most effective programme against sucking pests and was highly significant lower infestation levels by sucking pests. The highest reduction percentages of sucking pests 73.4% in aphid population, 51.9%, 58.13% and 68.96% in jassids, whiteflies and red spider mites populations, respectively in 2004 due to regime 9. While the reduction percentages were 65.4%, 48.92%, 29.23% and 42.76% in the populations of aphids, jassids, whiteflies and red spider mites, respectively as an average of early and late sown cotton, in 2005 cotton season. Earlier sown cotton gave significantly lower levels of infestation sucking pests than did latter grown cotton. Incidence of all sucking pests was significantly more in lower plant density except for red spider mites. The most abundance of sucking pests was the 3rd and 4th week of July. Ascorbic acid at the same rate of Salicylic acid 1 g/l was more effective in inducing resistance in cotton plants against sucking pests. Abamectin alone at 3 ml/10 L was relatively effective in reducing sucking pests especially red spider mite.

3. Side effect of IPM regimes on the incidence of sucking pests during boll formation period of 2004 and 2005 in organic and conventional cotton.

* Aphids: the most abundance of aphids was on 28th, 18th of Sept. in 2004 and on 25th of Sept. and 5th of October in 2005 cotton season in early and late cotton, respectively, in organic cotton Prog. 2 gave the lowest mean number of aphids in 2005 season 3.24 and Prog. 3 in 2005 season, 3.26 while the highest was recorded in untreated check 12.9 and 11.31 in 2004 and 2005, respectively, while 3.77, 4.19 and 4.27 were detected in Prog. 1, 3 and 4 in 2005 and 3.58, 3.63 and 4.02 aphids/5 leaves were shown in Prog. 4, 2 and 1, respectively in 2004 organic cotton season. The highest percentage reduction of aphids population on 74.88% was induced by regime 2 in organic cotton [Achook at 2 ml/l, Achook at 1 ml/l + *Trichodermma*, Spinosad at 25 ml/fed + cotton seed oil at 5 ml/l, Dipel at 2 g/l + Meanark at 5 g/l], while the lowest reduction in 2004 organic cotton 66.7% resulted from Prog. 4 [Agerin+ Achook at 1gm 1 ml/L, Agerin + Achook + *Trichodermma*, Spinosad at 50 ml/fed + Meenark at 5 g/l, Dipel at 2g/l at lower plant density, While in 2005, the highest reduction was induced by Prog. 3 and 4, the latter mentioned treatments 71.18% and 68.35%, respectively., while the lowest 64.46% in regime 1 (*Trichodermma*, Agerin, *Trichodermma* + Agerin, Spinosad at 50 ml/fed, Dipel at 2 g/l.

In conventional cotton regime 10 gave the lowest mean number of aphids/5 leaves in both seasons 4.46 and 4.43, respectively, followed by regime 11 and 9, 4.74, 5.01 and 5.37, 5.85, respectively, in 2004 and 2005, while the highest mean numbers were detected in untreated check 16.4 and 16.53/5 leaves in 2004 and 2005 seasons. The highest abundance 9.36, 9.8 individuals/5 leaves were detected on 21th, 31th of August and 28th of August and 7th of Sept. through inspection dates.

* Jassids: Prog. 1 was superior to 2, 3, 4 and untreated check in both seasons in reducing jassids population in organic cotton to 72.14%, 63.37% in 2005 and 2004. The highest incidence of jassids was detected on 18th and 28th of Sept. in both organic and conventional cotton. Earlier grown cotton resulted in lower levels of jassids than latter grown cotton, the best Prog. Resulted in highest reduction of jassids population was 71.86% in Prog. 8 in 2005 and 71.04% in Prog. 7 in 2004. Both aphids and jassids tend to be greater in number in lower plant density.

* Whiteflies: Treatments of Prog. 2 and 3 were most effective in reducing population of *B. tabaci* [Achook at 2 ml/l, Achook + *Trichoderma*, Spinosad at 25 ml/fed + C.S. oil at 5 ml/l, Dipel at 2 g/l] [Achook + Agerin at 1 ml, 1 g/l, Achook + Agerin + *Trichoderma*, Spinosad+ Meenark, Dipel at 2 g/l) in organic at 50 ml/fed. Cotton to 66.66%, 71.94% in 2004 and 74.88%, 76.86% in 2005, respectively. While Prog. 9 and 10 were most effective in reducing *B. tabaci* population in conventional cotton inducing 71.9, 74.1% in 2004 and 76.3%, 74.63% in 2005 [Curacron + Achook, Spinosad + Karate, Spinosad + Achook, Larvin + KZ oil], [Curacron+ Mat, P + C.S. oil, Spinosad + KZ oil, Larvin + Dipel). The highest abundance of *B. tabaci* occurred at the end of the season 28th of Sept. and 5th of October in both seasons. Population of *B. tabaci* tend to be relatively increased in lower plant density. Earlier grown cotton showed significantly lower population of *B. tabaci* than grower cotton in both seasons.

* *Tetranychus* spp.: Prog. 3 was most effective in reducing red spider mite population in organic cotton by 65.75%, 78.57% in 2005 and conventional respectively. While Prog. 10 and 11 were most effective (in conventional cotton) in reducing its population to 76.68 and 70.82% in 2005 and 2004. The most incidence of *Tetranychum* spp. was at the end of the season. The last week of Sept. and first week of October. Population of red spider mite was significantly lower in earlier grown cotton than that of latter grown one.

4. Effect of first spray of each IPM regimes on cotton leafworm *S. littoralis* in field during 2004 and 2005 in organic cotton

Regimes 4 and 3 [19th Agerin + 1 ml/l Achook] induced the highest percent average of initial effect after 6 days 86.3% and 79.18% followed by the treatment of Achook at 2 ml/l in Prog. 2, induced 77.23% average of initial effect, while Agerin at 2 g/l in Prog. 1 indicated the lowest 75.075% average of initial effect in organic cotton in 2004. While in 2005 season also, regimes 4 and 3 induced highest average % of initial effect after 6 days mounted to 81.1, 80.13% reduction,

followed by 77.88 and 77.35% in regimes 2 and 1, respectively, in organic cotton, expressed as average of both early and late cotton. While average of residual effect after 12 days from treatment, was also highest in regimes 4 and 3. 75.33% and 74.9%, respectively, followed by 72.03% and 71.23% in regimes 2 and 1, in regimes 2 and 1, respectively as an average of both early and late cotton in 2004, also, Prog. 4 and 3 induced 75.33% and 74.9%, as average percent of residual effect in 2005 organic cotton season, followed by 72.03 and 71.03% in regimes 2 and 1, respectively.

5. Effect of 1st spray of each IPM regime of conventional cotton on population of *S. littoralis* in 2004 and 2005

Curacron alone at 750 ml/l was efficient in reducing CLW populations in both seasons resulting in 81.63% and 71.93%, 83.43 and 74.05% average percent of initial and residual effects after 6 and 12 days in 2005 and 2004, respectively, while these percentages significantly increased up to 91.63% and 79.45, 87.6% and 76.12% in 2004 and 2005 by the treatment of Curacron + Mat. At half a rate each and were the highest averages % of initial and residual effect of all treatments (in regime 11), followed by 87.8, 73.85 and 89.6%, 76.48% in regime 10. i.e., C/W tends to be more in higher plant density. All combinations of Curacron at half a rate with half orate of other compound induced highly percent average initial and residual effect in reducing population of *S. littoralis*. The least mean no of *S. littoralis*/10 plants was 6.41 and 6.54 in regime 4 in organic cotton (2005 and 2004, respectively) and 5.3, 5.54 in regime 10 of conventional cotton 2004 and 2005, respectively.

6. Side effect of IPM regimes on predators prevailing in organic cotton and conventional cotton during 2004 and 2005 cotton seasons.

Mean numbers of predators were significantly higher in organic cotton than in conventional cotton during both season of 2004 and 2005. The prevailing predators in cotton field

Chrysopa spp.: Prog. 4 in organic cotton showed the highest mean number of *Ch. Spp.* in 2004 and 2005, 8.02, 9.38, respectively. Of all IPM regimes, while in untreated check 9.06 and 10.94 individual/15 plants. While conventional cotton untreated check recorded 8.38 and 8.4 in 2004 and 2005, respectively, while the highest mean number of *Ch. Spp.* 5.63 and 6.63 in regimes 8 and 7 in 2004 and 2005 seasons, respectively. The highest abundance of *Ch. Spp.* was in the last week of August and 1st week of Sept. during the period of inspection

True spider: This predator was most common in organic cotton, where it recorded 9.25 and 11.31 individual/15 plants in untreated check in 2004 and 2005, respectively, followed by 8.19 and 9.69 in both season, respectively, in conventional cotton, followed by 5.75, 6.75 in regimes 10 and 11 in 2004 and 2005, respectively. The highest abundance of this predator was recorded in the last week of August and 1st week of Sept. during the period of inspection.

Orius spp. untreated check showed the most incidence of this predator, 9.06 and 9.94 individual/15 plants in 2004 and 2005, followed by Prog. 4., 8.61 and 9.06 in 2004 and 2005, respectively, in organic cotton while the highest mean number 8.78 and 8 were detected in untreated check of conventional cotton, followed by 6 and 6.94 in regimes 9 and 10 respectively in 2004 and 2005. The most abundance of this predator was detected in the last week of August and the first week of Sept. during inspection period.

Paederus spp.: This predator was most abundant in untreated check in organic cotton, recording 8.45 and 9.25 in 2004 and 2005, respectively, followed by 7.59 and 8.88 in Prog. 1 and 3 respectively, in 2004 and 2005 seasons. While the highest mean number/15 plant was detected in untreated check of conventional cotton 6.94, 7.38 in 2004 and 2005 seasons, followed by 5.75 and 6.0 in Prog. 11 in both seasons. The most abundance of this predator was the last week of August and first week of Sept. during inspection period.

Coccinella spp.: untreated check of organic cotton showed the highest mean number of this predator/15 plants 8.69 and 10 individuals/15 plants followed by 7.63 in Prog. 1 in 2004 and 8.75 in Prog. 4 in 2005. While in conventional cotton untreated check showed 7.19 and 8.13 individual/15 plant in 2005, followed by 5.44 in Prog. 11 in 2004 and 6.5 in Prog. 7 in 2005 and was most abundant in the first week of Sept.

Scymnus sp.: The highest mean numbers of this predator 8.31 and 9.63 were detected in untreated check in 2004 and 2005, respectively., followed by 7.63 in Prog. 1 in 2004 and 8.75 in Prog. 4 in 2005 in organic cotton, while the highest mean number of *Scymnus* spp., 6.81 and 7.5 were detected in untreated check in conventional cotton in 2004 and 2005, respectively, followed by 5.63 and 5.94 in regime 7 in both seasons. The most abundance of this predator was detected in the first and 2nd week of July. Generally all predators were more abundant in earlier grown cotton the latter grown cotton and tend to be increased at lower plant density and their incidence was greater when incidence of sucking pests was, also greater in both seasons. Prog. 4 induced the least average % reduction in populations of predators during 2004 and 2005 expressed as average % reduction in both seasons in both early and late cotton 14.2%, followed by 16.55% in Prog. 3, 18.73% in Prog. 2 and the highest reduction 20.78 in Prog. 1. While in conventional cotton, Prog. 9 induced the lowest reduction in both seasons in both early and late cotton, 17.22%, followed by 18.88% in Prog. 7 and 20.48%, 20.72% in Prog. 11 and 10, respectively, and 24.4% in Prog. 8.

While, regime 6 induced the highest average % reduction 42.79% since, regime 6 was single chemical insecticides only at recommended dose [Curacron, Karate, Spinosad, Larvin) while when they were mixed with safer compounds at half a rate each, were more soft against predators in the other regimes, As they were mixed with Match, Agerin. Achook, KZ oil, cotton seed oil, Dipel and Spinosad, all are safe compounds, IGR mineral and plant oils. Biocides, Naturalyte and botanical insecticides all are safe and induced higher savings of predators.

Also, in combinations doses of toxic insecticides were reduced to the half. Consequently pollution would reduce and judicious use of insecticides was achieved as well as, the cost of control is supposed to be decreased. These safe compounds were soft on beneficial in organic cotton and allowed survival of considerably more beneficial and predators in organic cotton.

7. Percentages of losses in cotton yields in 2004 season.

Organic grown cotton: Generally Earlier grown cotton showed considerably less % losses than in latter grown cotton, the least % loss in yield 5.27% was estimated in earlier organic grown cotton in 2004, followed by 6.49% and 6.67% estimated in Prog. 4 and 4, respectively, while the highest 7.52% was estimated in Prog. 1. While in latter grown cotton, the highest % loss 9.25 was estimated in Prog. 2, followed by 8.87% in Prog. 1 while the most % loss 15.18, 15.77 were estimated in untreated check for early and late cotton, respectively.

Conventional grown cotton, the lowest % loss in yield in earlier grown cotton 4.55 was estimated in Prog. 11, followed by 4.9, 4.97, 5.52, 5.69 and 6.51 in Prog. 10, 9, 8, 7 and 6, respectively. While in latter grown cotton, the lowest % loss in yield was 7.79 in Prog. 11, followed by 8, 8.31, 9.14, 9.23 and 9.97% in Prog. 9, 7, 10, 8 and 6, respectively, while the highest % loss in yield 13.08% and 14.87% was estimated in earlier and latter cotton in untreated check in 2005 cotton season.

8. Percentages of losses in yield due to bollworms in 2005 season.

In organic cotton, the lowest % loss 5.6% was estimated in Prog. 4, followed by 5.83%, 6.1% and 7.05% in Prog. 3, 2 and 1, respectively in earlier grown cotton, while the highest % loss 11.78% was estimated in untreated check.

The highest % loss in latter organic cotton was 13.38 in untreated check, while the lowest % loss 6.74% was estimated in Prog. 4, followed by 7.27%, 7.86 and 8.56% in Prog. 3, 2 and 1, respectively.

In conventional cotton in 2005, the lowest % loss 4.55% was determined in Prog. 9 and 4.65% in Prog. 11, followed by 5.15%, 5.26%, 5.86 and 6.03% in Prog. 10, 8, 7 and 6, respectively, in earlier grown conventional cotton in 2005, while the highest % loss 11.01% was estimated in untreated check. The lowest % in late grown cotton 6.64% in Prog. 9, followed by 7.32%, 7.6%, 8.56%, 8.9% and 9.66% in regimes 11, 7, 10, 8 and 6, respectively while the highest % loss % 11.61 and 13.1% were estimated in untreated check earlier conventional cotton and latter conventional cotton, respectively.

9. Determination of larval storage % of PBW in dry bolls at harvest

It was estimated by collecting dry bolls). This larvae after diapausing would emerge to the new cotton crop, late in the following spring and constitute the

suicides generation. The values were expressed as an average of (early and late cotton) percent of living PBW in both early and late cotton dry bolls.

In organic cotton 2004: the lowest percent average number of living PBW in dry bolls 31.85 in Prog. 2, followed by 34.5% in Prog. 3 and was significantly lower than 38% and 42.6% in Prog. 1 and 4, respectively. While the highest 68.5% was estimated in the untreated check.

In organic cotton 2005: The lowest average percent of number of living PBW larvae was 36.5 in Prog. 4 and 2, followed by 38% and 40.5% in Prog. 1 and 3 and all were comparable to 46% in untreated check.

Conventional cotton in 2004 season: The lowest % of PBW larvae in dry bolls 29% in Prog. 8, 30.5 in Prog. 11 and were comparable to 32.98%, 33.5%, 33.5% in Prog. 9, 10 and 6 and which were in comparison with 46.95% in regime 7 and all were highly significant lower than 73.8% in untreated check.

Conventional cotton in 2005: The lowest average % of larval storage 27.5% was estimated in regime 7 which was significantly lower than 29.5%, 30% in Prog. 9 and 8, while in Prog. 10 and 11 was significantly higher 34 and 35%, respectively, and all were significantly lower than 36% in regime 6, while the highest average percentage of larval storage 59% was estimated in untreated check.

10. Organic cotton plants characters in 2004 and 2005

The treatment of 0.5 g/l of each salicylic acid and Ascorbic acid induced significantly greater plant height 143.05 cm as an average of early and late cotton, final plant height, in Prog. 4 and 138.45 cm in Prog. 3, and in Prog. 4 and 138.45 cm in Prog. 3 and were comparable to 136.8, 132.4 cm in Prog. 2 and 1, respectively and all were significantly high in comparison in the 116.2 in untreated check. The same treatment, also (0.5 g/l of each of Ascorbic acid and Salicylic acid in Prog. 4 and 3 induced significantly higher average no of fruiting branches 13.65, 12.7 compared with 12.2, 11.45 and 10.2 in Prog. 2, 1 and in treated check, also increased total bolls and open bolls/plant up to 27.8 and 25.75/plant, and 24.84 and 23.05 open bolls/plant in regimes 4 and 3, respectively, while the treatment of 1 g/l Ascorbic acid regime 2 exceeded the treatment of 1 g/l Salicylic acid Prog. 1 in giving higher total bolls, open bolls and fruiting branches/plant. Also, the treatment of 0.5 g/l of Ascorbic and Salicylic acid increased boll weight 2.69 and 2.64 compared with 2.62 in Ascorbic acid 1 g/l and 2.58 in salicylic acid at 1 g/l, compared to 2.45 gram in untreated check.

Also, in 2005 organic cotton, the average plant height at harvest, average no of fruiting branches, average total and open bolls/plant and average boll weight were significantly increased in the treatment of 0.5 g/l of Ascorbic and Salicylic acid. (Prog. 4 and Prog. 3) than in the treatment of Ascorbic acid at 1 g/l which exceeded the treatment of 1 g/l Salicylic acid in Prog. 1. Also, Prof. 4 (its plants at lower plant density) exceeded Prog. 3 which had the same treatment in increasing

fruiting bodies. Earlier grown cotton showed significantly higher values in fruiting bodies than latter organic grown cotton.

Average no. of seeds/boll and seed index (average weight of 100 seeds) average no of seeds/boll were greater in untreated check and regime 2, (17, 17) while the highest average no of seeds/boll was 17.25 in Prog. 3, the highest seed index 10.35 in regime 3 and the lowest 9.33 in untreated check in 2004. While the greatest no. of seeds/boll 16.5 in Prog. 4 and the highest seed index 10.2 in Prog. 4, too, in 2005 cotton season.

Conventional cotton: Prog. 9 resulted in greatest plant height 143.9 cm, 143.1 cm in 2004 and 2005, respectively. Also, inducing the greatest average no. of fruiting branches, total and open bolls/plant, average weight of boll, 13.55, 25.25, 25, 2.54, respectively. [0.2 g/l Greenzit_{SP100} + 0.5 g/l of each Ascorbic and Salicylic acid] and was comparable to the other treatment of IMP regimes. Also, the mentioned treatment of Prog. 9 gave the highest average no. of plant height, fruiting branches, total and open bolls/plant and average boll weight 143.1 cm, 13.73, 25.4, 17.81 and 2.63, respectively and was comparable to other treatments of IPM regimes in 2005 cotton season.

Average no. of seeds/boll was significantly greater 17.5, 17.4 in Prog. 9 and in untreated respectively in 205 and 17.9, 17.9, 17.8 in Prog. 8 and 7, respectively in 2004 season. While seed index was higher 10.7 in Prog. 9 in 2005 and 10.85 in untreated check in 2004.

Seed cotton yield

Seed cotton yield was estimated as an average of both yields of early and late grown cotton.

In 2004 cotton season, the highest seed cotton yield in organic cotton 11.35 Kent/fed was estimated in Prog. 4 and the lowest 6.18 was estimated in untreated check, cotton seed yield was significantly higher in IPM regimes in comparison with untreated check, the highest % increase in yield 83.66% over the untreated check in Prog. 4 and ranged from 83.66% in all IPM regimes. While in 2005, the highest seed cotton yield in organic cotton 7.7 Kent/fed was estimated in Prog. 3 and all IPM regimes achieved significantly higher yields than untreated check (4.95), the highest % increase in yield 55.56% in regime 3 and the lowest 32.25% in regime 1.

In Conventional cotton 2004: The yields of seed cotton of IPM regimes were significantly higher than in untreated check 5.76 Ken/fed. The highest yield 10.9 Kent/fed. Was estimated in Prog. 9 achieving 89.24% increase over untreated check, followed by 9.3 in Prog. 7, achieving 86.15% increase over check and the lowest 8.2 Kent/fed. In Prog. 10, resulting in 42.36 increase over check. Also, in 2005, all IPM regimes achieved significantly higher seed cotton yield than untreated check 4.93 Kent/fed. The highest 9.86 Kent/fed in Prog. 11 resulting in 100% increase over check, while the lowest 7.16 in regime 6 achieving 45.23% increase in yield

Impact of IPM regimes on fiber quality

Each value was expressed as an average value of both early and late grain cotton:

Organic cotton in 2004:

Untreated check gave significantly the shortest fiber length of 30.2 mm, while the (mm) 2.5% S.L. Longest fiber length 37.65, 37.3 were estimated in Prog. 4 and 3 respectively, and were in comparison with 36, 35.75 of Prog. 2 and 1, respectively, in 2004. While in 2005, the shortest fiber length 31.6 was measured in untreated check, the highest fiber length 38.2, 37.55 in Prog. 4 and 3, respectively and were comparable to 35.3, 34.7 mm in Prog. 2 and 1, respectively.

Uniformity

The least uniformity ratio 45.8 in untreated check, while Prog. 4 increased it up to 51 which was in comparison with 49.95, 48.45 and 48 in Prog. 2, 3 and 1 in 2004. while in 2005, also, the least 44.5 was measured in untreated check, while Prog. 4 increased it up to 51.25 which was significantly the greatest uniformity ratio.

Tenacity (g/tex)

Untreated check in 2004 showed the least tenacity 29.15, while Prog. 4 resulted in increasing tenacity up to 37.9 g/tex which was superior to other IPM regimes while in 2005, also, untreated check gave the lowest tenacity 30.3, while Prog. 4 increased it up to 37.8 and was comparable to other regimes.

Elongation

Untreated check gave the least value of elongation in both seasons 2004 and 2005, 4.1 and 4.3, respectively, while Prog. 4 increased it up to 4.7 in 2004 and was comparable to other IPM regimes, while increased it up to 4.8 in 2005.

Micronaire reading

The least micronaire reading 4.05 was measured in untreated check, while regime 3 increased it up to 4.65 which was comparable to the other IPM regime in 2004. Also, the least value of micronaire 4.15 in untreated check in 2005. While the highest 4.55 which was comparable to the other IPM regimes in 2004. Also, the least value of micronaire 4.15 in untreated check in 2005. While the highest 4.55 was measured in Prog. 3 without any significant differences.

Conventional cotton

Fiber length (mm) 2.5% S.L

Prog. 9, 10, 11 prolonged fiber length up to 36.6, 36.55, 36.4, respectively over the untreated check 34.55 and were in comparison with other IPM regime while regimes, shortened the 33.85 mm in 2004, while in 2005, untreated check gave the shortest fiber length 29.4 mm while the longest fiber length 38.4, 37 and 36.8 were given by Prof. 11, 9 and 8, respectively, while regime 6, gave significantly shorter fiber length 35.4 which was significantly longer than untreated check.

Uniformity:

Also, untreated check showed the least uniformity ratio 45.3 in 2004 compared with 51, 50.4, 50.2 in Prog. 11, 9 and 10 and were comparable to the values of other IPM regimes. Also, in 2005 season, the untreated check gave the least uniformity ratio 44.5, while Prof. 10, 9 and 8 increased it up to 53, 51.1 and 50.9, respectively. While Prof. 11 and 7 increased it up to 49.9 and 49.5 and were comparable to 47.15 in regime 6.

Tenacity (g/tex)

Regimes 9, 11 increased tenacity up to 37.15, 36.7 over untreated check 30.2, while, Prog. 8 and 7 increased it up to 36.5, 35.7 over check, regime 6 decreased it to 29.1 g/tex in 2004, while in 2005, Prog. 6.9 increased tenacity up to 36.7, 36.65 over check 31.25 and were comparable to the values of other IPM regimes.

Elongation

The highest values 5.1 and 4.9 in regimes 11 and 10 and were comparable to other IPM regimes and untreated check 4.05 in 2004, in 2005 season. The highest values of elongations 5.2 and 5.0 gives in regimes 11 and 10 and were comparable to other IMP regimes and untreated check 4.25.

Micronaire reading:

The highest value 4.35 in regime 6 and was in comparison with all other values of IMP regimes and untreated check 3.9 in 2004. While in 2005, also, regimes 6 gave the highest micronaire reading 4.5 and was comparable to the values of IPM, regimes and untreated check (4.0).

It could be concluded that regimes 3, 4 which were applied to organic cotton were the best in reducing bollworms infestation levels during 2004 and 2005 cotton seasons. [0.5 g/l Ascorbic acid + 0.5 g/l Salicylic acid and 1 L/fed. Liquid potassium soap produced from cotton seed oil at the beginning of flowering stage I [1 g/l Agerin + 1 ml/l Achook, followed by releasing *Trichogramma evenescens*, than 1 h/l Agerin + 1 ml/l Achook, followed by Spinosad at 50 ml/fed + Meenark at 5 g/l improves its performance or C.S. oil at 5 ml/l, then Dipel at 2 g/l], Prog. 3 was higher plant density while Prog. 4 was lower plant density. This Prog. Reduced significantly infestation levels by bollworms and was efficient against non target insects [sucking pests and C/W] and induced a great number of predators, improved cotton plants characters and increased fruiting organs, consequently increased seed cotton yield and had the least % loss due to bollworms, and resulting in better fiber quality compared with untreated check or other IPM regimes of organic cotton. While in conventional cotton it could be recommended Prog. 11, 10 and 9 since they reduced significantly infestation levels by bollworms, gave good control of non-target insects [Sucking pests and C/W] and induced savings of predators. Also, Prof. 9 induced the highest average no of boll weight, plant height, total bolls and open bolls/plant, consequently showed the highest seed cotton yield and resulted in the least % yield loss and increased fiber quality properties [length, tenacity-uniformity and elongation], Prog. 9 [0.2 g/l Greenzit + 0.5 g/l Ascorbic acid + 0.5 g/l Salicylic acid, Abamectin (Romectin[®]) at 3 ml/10 L at

the beginning of flowering period], during growing seasons of 2004 and 2005, [Achook + Curacron, Spinosad + Karate, Spinosad + Achook, Larvin+ KZ oil] at half a rate of each compound in a combination], while Prog 10 and 11 [Romectin® at 3 ml/l and Deflowering began at the beginning of flowering period for 25 days and during the formation of bolls. It was sprayed [Curacron+ Mat, P + C.S.O., Spinosad + KZ oil, Larvin + Dipel] each compound in a mixture was at a half a rate, Prog. 10 its plants were grown at nearest plant spacing, while Prog. 11 its plants were grown at lower plant density.

Also, judicious use of toxic insecticides was achieved through mixtures which reduced the dose of toxic insecticides by mixing with relatively safe products, Achook, a neem based product, Agerin and Dipel, Bioinsecticides, cotton seed oil and KZ oil, plant and mineral oil, therefore these mixtures were soft against predators and resulted in saving predator besides, their efficiency against target and non-target insects, also, increased cotton plants characters and fruiting bodies, consequently yields of seed cotton and contributed to increasing fiber quality, also, reduced pollution. Generally Earlier grown cotton showed significantly lower levels of infestation by bollworms and non-target insects [sucking pests and C/W] and higher levels of predators than grown cotton. The effects of interaction of sowing data with treatments of IPM regimes and inspection dates were significant on infestation by bollworms and incidence of sucking pests. Populations of *E. insulana* were greater in lower plant density, on the contrary, populations of *P. gossypiella* were greater in higher plant density. Applying foliar treatments at the start of flowering period, Ascorbic acid and salicylic acid at 1 g/l each, increased plant resistance against bollworms sucking pests, Ascorbic acid was more efficient than Salicylic acid, a foliar fertilizer, Greenzit_{SP100} at 0.2 g/l increased tolerance of plants against infestation by bollworms and sucking pests. Its efficiency was increased when Ascorbic acid at 1 g/l or Salicylic acid at 1 g/l was sprayed and its efficacy significantly increased against bollworms and sucking insects when Ascorbic and Salicylic acid were sprayed at 0.5 g/l each, after spraying Greenzit at 0.2 g/l.