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Summary

The insecticidal activities of four compounds namely chlorpyrifos (OPI), cypermethrin (pyrethroid insecticides) and chlorfluazuron (IGRs) and spinosad (biotic insecticides) applied either separately or in mixture with EBI fungicides or IGRs were investigated against the cotton leaf worm *S. littoralis* and the pink bollworm *P. gossypiella*. Larvae of the insects were reared in laboratory on castor bean leaves or on artificial diet treated with different concentrations of each compound and LC₅₀ values were recorded.

1 -In laboratory bioassay

1-1-Cotton leaf worm

The results indicated that toxicity and synergistic action of chlorpyrifos (OPI), cypermethrin (pyrethroid insecticides) and chlorfluazuron (IGRs) and spinosad (biotic insecticides) used alone or in mixtures with EBI fungicides or IGRs at different concentrations to the 4th instar larvae of *S. littoralis*. The present data proved that LC₅₀ of chlorpyrifos (OPI), cypermethrin (pyrethroid insecticides) and chlorfluazuron (IGRs) and spinosad (biotic insecticides) were 6.08, 7.66, 2.06 and 4.11 ppm when these compounds were used alone respectively. Also data indicate that the LC₅₀ values were decreased when these compounds were mixed with EBI fungicides or insect growth regulator. The LC₅₀ values were 2.34, 3.72, 2.51, 3.4 and 2.8 ppm when chlorpyrifos was combined with difenoconazol, tetraconazol, imazalil, fenarimol as EBI fungicides and chlorfluazuron as IGR respectively. This result may be due to increase insecticidal action by 2.59, 1.63, 2.42, 1.78 and 2.17 folds respectively. Also these values decreased when cypermethrin was mixed with both EBI fungicides and IGR. These values were 2.88, 2.95, 2.38, 2.77 and 3.4 ppm respectively, compared with 7.66 ppm when used alone. The insecticidal action increased by 2.63, 2.57, 3.19, 2.77 and 2.23 folds

respectively. Also, these values decreased when chlorfluazuron was combined with EBI fungicides these values were 0.97, 0.99, 1.75, and 1.18 ppm when mixed with difenoconazol, tetraconazol, imazalil, fenarimol respectively, compared with 2.06 ppm when this compound was used alone. The toxicity of this compound increased by 2.12, 2.08, 1.21 and 1.74 folds respectively. Also the same data indicate that the decrease in the LC_{50} values when the spinosad was mixed with EBI fungicides or IGR and the values were 3.37, 3.5, 2.72, 3.45 and 1.68 ppm when mixed with difenoconazol, tetraconazol, imazalil, fenarimol and the IGR chlorfluazuron, respectively compared with 4.11 ppm for spinosad when used alone. The insecticidal action increased by 1.21, 1.17, 1.52, 1.22 and 2.44 folds respectively.

1-2- pink boll worm

The results indicate that, toxicity and synergistic action of the tested compound used alone or in mixtures with EBI fungicides or IGR at different concentrations to the newly hatched larvae of *P. gossypiella*. The present data proved that LC_{50} of chlorpyrifos, cypermethrin, chlorfluazuron and spinosad were 2.89, 3.01, 1.01 and 1.54 ppm when used alone respectively. Data indicate that the LC_{50} values, were decreased when these compounds were mixed with EBI fungicides or IGR. The LC_{50} values were 0.88, 0.48, 0.26, 0.26 and 0.13 ppm when chlorpyrifos was combined with difenoconazol, tetraconazole, imazalil, fenarimol as EBI fungicide and chlorfluazuron as IGR respectively, compared with 2.89 ppm when used alone. This indicate that insecticidal action increased by 3.2, 6.02, 14.45, 11.11 and 22.23 folds respectively. Also these values decreased when cypermethrin was mixed with both EBI fungicides or IGR. These values were 1.95, 0.85, 1.01, 0.65 and 1.5 ppm respectively, compared with 3.01 ppm when cypermethrin was used alone. The insecticidal action increased by 1.54, 3.54, 2.98, 4.63 and 2.01

folds respectively. These values were decreased when chlorfluazuron was combined with EBI fungicides however these values were 0.61, 0.11, 0.36 and 0.29 ppm when mixed with difenoconazol, tetraconazol, imazalil, fenarimol respectively, compared with 1.01 ppm when this compound was used alone. The toxicity of this compound increased by 6.01, 9.18, 2.85 and 3.48 folds respectively. Also the same data indicated that the decrease in the LC₅₀ values when the spinosad was mixed with EBI) fungicides or IGR and these values were 0.51, 0.41, 0.78, 0.61 and 0.56 ppm when mixed with difenoconazol, tetraconazol, imazalil, fenarimol and the IGRs chlorfluazuron respectively, compared with 1.54 ppm for Spinosad when used alone. The insecticidal action increased by 3.08, 3.21, 1.97, 2.56 and 2.75 folds respectively.

2- Field bioassay

\2-1-cotton leaf worm

In field studies throughout the two seasons (2006 and 2007), clearly, indicate that the field application of insecticides at full and half recommended rate alone or in combination with EBI fungicides or insect growth regulator caused significant mortality in the 4th instars larvae of *S.littoralis* after different treatments and periods. Mortality among *S. littoralis*' after different treatments and periods when mixing the half recommended rate with EBI fungicides and insect growth regulator was very increased in the two seasons compared with the insecticides used alone. Also, all the tested compounds whether used alone or in mixtures with EBI fungicides and insect growth regulator in laboratory at different concentrations or in field at half recommended rate indicated that

- 1- Comparing the results of the two tested insects, it was found that larvae of *P. gossypiella* were somewhat more

sensitive to test compounds than larvae of *S. littoralis*. Also insecticides had higher larvicidal activity when mixed with EBI fungicides or IGRs

- 2- All the tested compounds, in mixtures with EBI fungicides or IGRS caused higher percentage of larval mortality
- 3- Higher percent of pupal mortality of both insects were observed when larvae fed on food containing insecticides-fungicides or IGRs than the insecticides alone
- 4- High reduction of adults emergence were observed when larvae of both insects were fed on food containing insecticides-fungicides or the IGRs
- 5- All treatments containing insecticides-fungicides or IGRs at all concentration decreased or completely inhibited oviposition than insecticides alone.
- 6- Generally, mixtures of insecticides and EBI fungicides or IGRs and at low concentration gave better results than that obtained by using high concentration of all compounds alone against both insects

2-2- cotton boll worms

Also, the same trend of effectiveness of the insecticides increased by adding EBI fungicides and the insect growth regulator to the half recommended rate. In field studies throughout the two seasons (2006 and 2007), the results clearly, indicated that the field application of insecticides at full and half recommended rate alone or in combination with EBI fungicides or insect growth regulator caused significant reduction percentage in infestation of cotton bolls by boll worms after different treatments and periods in the two seasons. Reduction percentage among boll worms after different treatments and periods when mixing the half recommended rate with EBI fungicides and insect

growth regulator was increased in the two seasons compared with the insecticides used only.

Thus, it could be mentioned that using low doses of insecticide- EBI fungicides or IGRs mixtures gave excellent control of the both insects compared to their high doses at the same time also minimize the environmental pollution.