CHAPTER - VI

SUMMARY

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Pigeonpea (*Cajanus cajan* (L) Millsp) is one of the most extensively cultivated pulse crops in India and several other countries. In India, it is grown in an area of about 3.82 million hectares with an annual grain yield of about 2.88 million tonnes. Among the various stresses, fusarial wilt caused by *F. udum*, a soil inhabitant is most important and therefore requires extensive study pertaining to its management.

Like any other soil-borne fungal disease, it is difficult to control this disease as well. Several methods have been suggested by various workers from time to time to control this disease. Pesticides, soil solarization, cultural practices, antagonistic microbes, essential oils, oil cakes and crop residues have been suggested but without significant success.

Considering the importance of the crop and the disease, an attempt has been made through this study to develop integrated management of this disease.

Majer findings and conclusions generated through this investigation are as follows:

Isolations from wilted plants invariably yielded *F. udum*. The Koch's postulate too proved the cause as *F. udum*.

In-vitro interactions between the test pathogen and some dominant rhizosphere fungi, were studied. *Aspergillus niger*, *A. flavus*, *Rhizoctonia solani*, *Gliocladium virens*, *Trichoderma harzianum*, *Penicillium citrinum*, *A. luchuensis*, and *Trichoderma viride* were observed to be highly antagonistic against *F. udum*. *Gliocladium*

virens and *Trichoderma spp.* overgrew the colony of the test pathogen, and checked its growth.

The culture filtrates of the antagonistic fungi inhibited the radial growth of *F. udum* to various extent. This effectiveness was recorded in an order of *Aspergillus niger* > *A. flavus* > *Trichoderma horzianum* > *Gliocladium virens* > *P. citrinum* > *A. terreus* > *A. luchuensis* > *Trichoderma viride* > *Alternaria alternata* > *Cladosporium cladosporioides.*

Bacillus licheniformis strain-2042 was found to be highly antagonistic against the test pathogen. Similarly, the culture filtrates of the bacteria inhibited the radial growth of *F. udum.* The degree of inhibition was recorded in the following order:

Bacillus licheniformis strain-2042 > Unidentified bacteria No.1 > Unidentified bacteria No.2 > *Bacillus thuringiensis* > *Bacillus licheniformis* strain - 2044.

Oil-cakes of coconut, linseed, mustard and neem caused partial inhibition in the radial growth of *F. udum* . The relative efficacy of oil-cakes were recorded as coconut > neem > mustard > linseed.

The essential oils of *Aegle marmelos* and *Eucalyptus citridora* inhibited growth of the pathogen completely at 2000ppm. However, oils of *Calistemon lanciolatus* and *Eupatorium cannabinum* inhibited the growth upto 74.8% and 80.9%, respectively invitro.

In general, the percent and magnitude inhibition of the growth of *F. udum* increased proportionately with the increase in concentrations of oil cakes, essential oils and the pesticides.

Amendment of natural soil with antagonists such as *Aspergillus niger* and *Penicillium citrinum* at 3% concentration was

highly effective giving almost 100% control. Other effective antagonists were *Trichoderma harzianum and Gliocladium virens* giving 83.8 to 91.6% disease reduction respectively. *Bacillus licheniformis* strain - 2042 effectively managed disease (66.6%). In sterilized soil, however, complete disease management in pots was observed in soils amended as the *A. niger, G. virens* and *P. citrinum* followed by *T. harzianum* (92.5%), *B. licheniformis* strain-2042 (74.6%) at 3% concentration each.

The essential oils from *Aegle marmelos* and *Eucalyptus citriodora* in natural soil controlled disease to the extent of 83.8% and 75%, respectively, whereas in sterilized soil, the essential oils of *A. marmelos* and *E. citriodora* were found to be most effective at 3% concentration, yielding disease suppression upto 89% and 82.5%, respectively.

In general, the percent disease management increased with increasing concentrations of antagonists, essential oils, oil cakes, and pesticides both in natural and sterilized soil. The disease management was more pronounced in sterilized soil.

Effect of soil amendments with antagonists, essential oils, oil cakes and pesticides amended in natural soil and sterilized soil at different concentrations were also observed on population dynamics of *F. udum* and on the rhizosphere mycoflora of pigeonpea at initial sampling (Seedling stage) and final sampling (When the plant started showing symptoms of complete wilting).

In case of amendments with antagonists at 3%, the population of the pathogen declined sharply reaching almost zero in case of *A. niger* (natural and sterilized soil) and *P. citrinum* (sterilized soil) in the final sampling. The population of the

pathogen was maximum in case of amendment with *A.flavus* followed by *B. licheniformis* strain-2042 *G. virens, P. citrinum* and *T. harzianum.* Among the antagonists *A. niger, P. citrinum, G. virens, T. harzianum, B. licheniformis* strain-2042 dominated the population dynamics. The population of the pathogen declined with the increase in concentrations of antagonists.

The maximum reduction in population of the pathogen was observed with essential oil from *A. marmelos.* The treatment also increased rhizosphere fungal flora. A reduction in population of the pathogen was observed more in final sampling than as the initial stage. In general the population of the pathogen decreased with increase in concentration of essential oil.

Integrated effect of antagonists, essential oil, oil-cake and fungicides viz., *A. niger, G. virens, P. citrinum* and *T. harzianum,* essential oils of *A. marmelos,* oil cake of *A. indica* and the fungicides MeMc and Bavistin, were found most potent against the test pathogen invitro and invivo. They were selected for the above study. The LD_{50} concentration of essential oil, oil-cake and fungicides were integrated with 20% metabolites of different antagonists in different combinations and were used for the study.

The combination of *A. niger* with *A. marmelos* inhibited the radial growth of *F.udum* by 72%, followed by *G. virens* with *A. mamelos* by 63.8%, *T. harzianum,* with *A. marmelos* by 62.4% and *P. citrinum* with *A. marmelos* by 45.6%.

Integrated effect of the antagonists with oil cake of *A. indica* and fungicides Bavistin were observed on wilt disease of pigeonpea under potted conditions. Maximum disease management was observed after an integration of *G. virens* with *A. indica* and

Bavistin (83.8%). The integration of *P. citrinum* with *A. indica* and Bavistin yielded disease management by over 66%, followed by combination of *A. niger* with *A. indica* and Bavistin(63.8%). The management of Fusarium wilt disease of pigeonpea was minimum when *T. harzianum* was integrated with *A. indica* and Bavistin (53.8%).

Soil amendments with antagonists like *A. niger, G. virens, P. citrinum* and *T. harzianum* together with oil cake of *A. indica* and fungicide Bavistin was studied on population dynamics of *F.udum* and the rhizosphere mycoflora of pigeonpea in natural soil. The population of the pathogen was inhibited maximally under integration of *G. virens* with *A. indica* and Bavistin followed by that of *P. citrinum* with *A. indica* and Bavistin. of *A. niger* with *Azadirachta indica* and Bavistin and of *T. harzianum* with *A. indica* and Bavistin. Further, the population of the pathogen declined with ageing of the host in all the cases. Regarding the rhizosphere fungal population, the number of colony forming unit (CFU) increased with time and the maximum fungal population was obtained in case of integration of *T. harzianum* with *A. indica* and Bavistin while minimum with that of *A. niger* with *A. indica* and Bavistin. In general, population of the antagonists increased with increase in time. The maximum population amongst the antagonist was recorded for *A. niger* during final sampling.

CONCLUSION

It is concluded that the integration of formulated propagules of *Gliocladium virens* with *Azadirachata indica* (oil-cake) and low concentration (0.1%) of Bavistin could significantly control the wilt disease of pigeonpea in field.