INTEGRATED MANAGEMENT OF BACTERIAL WILT OF GINGER

INTRODUCTION

In India ginger (*Zingiber officinale* Rosc.) is infected with bacterial wilt caused by *Pseudomonas solanacearum* (E. F. Smith), which is the most serious disease causing heavy losses in yield. A severe outbreak of bacterial wilt caused by *P. Solanacearum* biotype III was noticed during 1978 at Ambalavayal in Wynad district which spread into other major ginger growing areas of Kerala.

SYMPTOMATOLOGY

The conspicuous are flaccidity and curling of leaf margins. Yellowing starts from lower most leaf and gradually progresses to upper leaves. The pseudostem at collar region becomes water soaked and breaks away from the rhizome at ground level. In the advanced stage, plants exhibit severe yellowing and wilting symptoms. Vascular tissues of affected pseudostems show dark streaks. The affected pseudostem or the rhizome when pressed gently, exudes the milky ooze from the vascular strands, since both fungal and bacterial infection occurs simultaneously in nature. Wrong identity and thereby the wrong choice of the chemical quite often render control measures ineffective. The soft rot can be distinguished from bacterial wilt by the absence of milky bacterial ooze when the rhizome or pseudostem is cut transversely.

CONSTRAINTS

Since the disease is both soil and seed borne, it is less amenable to control. In many ginger growing tracts especially in Wynad district of Kerala, much of the available land is already infested. This is particularly true in small holdings where land scarcity restricts crop rotations. The benefits of expensive pathogen free seed rhizomes are negated with the limited land available for growing ginger, already infested as a result of previous crops or weed hosts. Moreover, *P. solanacearum* is carried over long range vegetative propagating materials. Use of such unregulated infected ginger rhizomes as planting material has amplified and extended a severe disease problem in Kerala.

Absence of a foolproof technique to detect seed borne inoculum in apparently normal rhizomes is another handicap. Ideally, the bacterial wilt can be avoided by ensuring that the soil and seed rhizomes are free of the pathogen. At present, farmers rely mostly on presence or absence of symptoms to indicate whether soils and harvested rhizomes are pathogen free. In practice, routine techniques used to detect the bacterium in soil and plant materials have lacked the level of sensitivity required for reliable seed rhizome selection. The movement of infected seed rhizomes from infected to non-infected areas continues to abet the large scale spread of *P.solanacearum* throughout Kerala.

Ginger is propagated exculsively by vegetative means because of lack of seed set. Hence, the conventional approach in ginger breeding and selection for disease resistance are

especially difficult. Poor genetic base with little variability for disease resistance and absence of seed set are a few of the hurdles in the crop improvement programme.

Antibiotics streptomycin sulphate/streptocycline (200 ppm) are effective to inhibit the bacterial growth *in vitro* but are ineffective *in vivo* because of fairly heavy and well distributed showers during the crop growth period June-October. The bacterium *P.solanacearum* gets inhibited at a particular concentration only. Therefore, if there is heavy downpour after drenching, the applied/drenched antibiotics either get diluted or washed away, resulting in poor control. Bacteriocides so for tried as seed treatment as well as drenches were found less effective and uneconomical. Being a soil and seed borne disease, it is very difficult to eliminate bacterium through chemicals. Moreover it is not cost effective.

In Kerala, the crop is rainfed and cultivated from sea level to an altitude of 1500 m. The crop at sprouting stage is more vulnerable to infection because of its tender and succulent tissues. A warm and humid climate predisposes the plant to infection. Bacterial wilt of ginger in the field may either originate from infected seed rhizomes or soil. Once the plant is infected, it results in total loss of clumps. The spread is non random, typical of soil borne disease. The spread is through soil water and along the gradient of the field. But water splashes also aid the spread even against the gradient. It is clear that the warm humid climate and rainfall help to produce bacterial ooze more rapidly from infected pseudostems and in disease spread to the adjacent plant within the bed through film of water from clump to clump as the distance between plant to plant is short. The bacterial ooze gets mixed in film of water and gets dispersed alongwith gradient slope. The severity of infection depends on quantity of inoculum produced at the start of initial infection, favourable weather for pathogen and subsequent infection and rain splash to dispear the bacterium during this period.

MANAGEMENT STRATEGIES

CULTURAL METHODS

1. The disease is severe when a ginger is grown every year on the same land because of persistence of the pathogen in soil. Rotate ginger with crops which are not susceptible to bacterial wilt. More over, being an exhaustive crop, it is not desirable to grow ginger in the same site year after year.

2. Poor drainage and water stagnation predispose the crop to infection. Heavy soils with high moisture holding capacity are conductive for disease development. The disease incidence is more during June-October coinciding with south-west monsoon. Therefore, well drained seed bed sites should be selected. Provision of adequate drainage channels in the plot is a must to avoid disease incidence and spread.

3. Healthy rhizomes from disease free ginger area are to be selected as seed rhizomes. At the time of harvest, rouging of suspected infected clump is a must to prevent carry over of inoculum to subsequent ginger crop.

4. Treat the selected seed rhizomes with streptocycline (200 ppm) for 30 minutes, drain off excess solution and shade dry the rhizome.

5. The root knot nematode infestation in ginger enhances development of bacterial wilt. Care should

be taken to control nematode infestation.

6. Many weeds are getting infected with bacterium with or without showing any symptoms. Therefore, ginger field should be kept free from weed hosts to minimize infection. Mulching and earthing up are to be carried out at 40 and 90 days after planting, immediately after weeding and application of fertilizers. If sufficient care are not taken properly, the disease may spread through contaminated equipments/ implements. All tools and equipments used in the seed beds must be disinfected for effective reduction in spread of disease and minimize loss in yield, otherwise inoculum potential will reach excessive levels leading to severe crop loss.

7. Phytosanitary measures are to be takenup once the disease is noticed in the field. Several times the outbreak in poorly managed infected seed beds leads to high inoculum potentials at test sites. The diseased clumps should be removed and soil surrounding this should be drenched with suitable antibiotics as spot application to minimize further spread of the disease.

CHEMICAL CONTROL

Studies carried out so far indicated that treatment of seed rhizomes with streptocycline (200 ppm) and subsequent drenches with 10 litres/3sq m kept the disease under check for three months, but subsequently they succumbed to disease. Soil treatment with streptocycline, bordeaux mixture (1%) or application of bleaching powder was partly effective but not cost effective.

RESISTANCE

Disease resistance has not been reported so far in the germplasm material tested against *P. solanacearum*

Studies are in progress for evolving disease resistant types by inducing somclonal variation through callus and cell culture and also to identify resistance to *P. solanacearum* using toxins to screen the cultures and callus for resistance.

BIOLOGICAL CONTROL

Efforts are on to identify avirulent strains of *P.solanacearum* for using in biological control of the disease. There is scope for utilizing biological control agents as complementary strategies to manage bacterial wilt caused by *P.solanacearum* (biotypes III&IV), in combination with resistant cultivars, crop rotation with non-host crops, nematode and weed control, establishment of strict quarantine measures (restriction on movement of infected seed rhizomes), improved seed storage and farm management practices.

CONCLUSION

Under the above situation, integrated management strategy incorporating one of the resistant cultivars and adopting appropriate cropping sequences and cultural practices can alter suitability of the micro-environment conducive to the pathogen and hence reduce disease incidence. Efficiency of a particular system is location specific, hence, it must be adopted to suit local climate, soil type, pathogen strain, farming system and the socio-economic situation.

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