



REGULAR ARTICLE

STUDIES ON STATUS AND HOST RANGE OF SOFT ROT DISEASE OF CABBAGE (*BRASSICA OLERACEA* VAR *CAPITATA*) IN KASHMIR VALLEY

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SUMMARY

Cabbage (*Brassica oleracea* var. *capitata*) is one of the most important vegetable crops grown in Kashmir throughout the year. The crop suffers considerably because of soft rot. Survey conducted during 2008-09 revealed that soft rot of cabbage is prevalent in all the vegetable markets of Kashmir Valley. The disease was considerably higher in two of the districts viz. Anantnag and Baramullah than Srinagar. The highest incidence was recorded in Anantnag. Upon isolation the causal pathogen responsible for soft rot in cabbage under temperate conditions of valley was identified as *Erwinia carotovora* sub-sp. *carotovora*. Studies on host range of the bacterium under artificial inoculation revealed that all the seven tested vegetable species, representative of the families, were susceptible to soft rot.

Key words: Soft rot, *Erwinia carotovora* sub-sp. *carotovora*, Host range

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1. Introduction

Cabbage (*Brassica oleracea* var. *capitata*) is grown in almost all vegetable growing areas of Kashmir Valley primarily as a winter crop and sometimes also as summer vegetable. In Kashmir valley it is grown on an area 1,964 ha with a production of 39,280 tonnes (Anonymous, 2007). Although different fungal diseases in cabbage had received ample attention of plant pathologists, but little work has been done so far about the diseases of bacterial origin in India in general and the state of Jammu and Kashmir in particular. Soft rot is one of the destructive diseases prevalent in the area. It occurs worldwide wherever fleshy storage tissues of vegetables and ornamentals are found. The disease can be found on crops in the field, transit, and storage or during marketing; resulting in great economic losses. Soft rot causes greater total loss of produce than any other bacterial disease. Post harvest bacterial soft rot losses have been estimated to vary between 15-30 percent of the harvested crop

(Agrios, 2007). Vegetables coming from the field may be already infected although they may not yet show visible symptoms at harvest which later on may cause severe damage at high temperature and humidity. The problem gets aggravated due to respiration of the living cells and poor transport technology. Present investigation was carried as no efforts till date have been carried out to explore the status and host range and actual cause of the soft rot in the valley.

2. Materials and Methods

Status of soft rot of cabbage in Kashmir

A survey of important vegetable markets were conducted for assessing the prevalence of soft rot of cabbage at periodical intervals of every two months starting from February 2008 to December 2009. Three major districts were chosen viz. Baramulla, Anantnag, and Srinagar. Three locations, with three sub-locations each, were randomly selected.

Godowns and vegetable shops were surveyed to record the status of bacterial soft rot of cabbage. Each package in stores / shops was keenly observed for soft rot symptoms. Total number of cabbage heads and those showing soft rot symptoms were recorded and percent disease incidence and severity was calculated using standard formula.

Isolation of pathogen

Diseased cabbage heads bearing typical soft rot lesions were selected for isolation of pathogen. The isolated pathogen was characterized on the basis of pathogenicity on cabbage, morphological and biochemical characters.

Host Range Study

Seven different vegetable species *viz.* carrot (*Dacus carota*), cucumber (*Cucumis sativa*), onion (*Allium cepa*), potato (*Solanum tuberosum*), knol khol (*B. oleracea var caulorapa*), cauliflower (*B. oleracea var botrytis*), tomato (*Lycopersicon esculentum*), belonging to different families were tested for host range studied of the pathogen. The tests were carried on fresh fruits, tubers, bulbs, curds, and knobs. The test were conducted by modified technique of DeBoer *et al.*(1978). The plant parts to be tested were surface sterilized by immersing them into 0.1 % sodium hypochlorite and then washed twice with sterile distilled water followed by air drying under a laminar flow hood. A drop of an aqueous cell suspension of the test bacterium (10^8 cfu/ml obtained from 24 hour old growth) was applied with the help of a sterile pipette on each vegetable part and a flamed straight pin was inserted through the drop and into the center of vegetable part and then withdrawn. Five replications were maintained in each case. The inoculated vegetable parts were put in sterile plastic bags to maintain high humidity before being sealed. The bags were incubated at 30°C and the observations were recorded on days taken to express first symptom and soft rot intensity after 4 days (96 hours). Disease intensity was measured as degree of tissue maceration on 0-5 scale.

3. Result and Discussion

Status of soft rot of cabbage

During the course of survey it was found that soft rot of cabbage is prevalent in all the wholesale and retail markets of the Kashmir valley with varied incidence and severity at different locations (Fig-3) and during different months of the year (Fig-1 and 2) Periodic surveys and Upon comparison of the weather parameters of temperature and humidity over the year 2008 and 2009 it is clear from Fig. 1 and Fig.2 that the disease is severe in hot summer months and comparatively less severe in cooler months of the year (Fig-1 and 2). The highest disease incidence and severity was observed in June to August followed by October and December, respectively. Both incidence and severity were lowest in February and increased steadily from April with the increase in temperature. In February, lesions were present on cabbage heads imported from warmer regions, out side the state, which failed to develop in cool temperature prevalent during the time in Kashmir markets (Fig-1 and 2). As the temperature increases the disease also increases reaching its peak during June and from August onwards again starts decreasing. The increased damage of soft rot disease of cabbage at higher temperatures has been reported previously by Bhat *et al.*(2010). Raju *et al.* (2008) also reported enhancement of soft rot disease at increased temperatures of 20 to 30°C. Kikumato (1974) also reported prevalence of soft rot disease in Chinese cabbage from early summer to autumn and rapid disease development at higher temperatures. Among the districts surveyed disease incidence was highest in district Anantnag followed by Baramulla and least was in district Srinagar. (Fig-1) It is worthwhile to mention that cabbage is supplied to distant district of Anantnag and Baramulla from wholesale vegetable market of Parimpora located in district Srinagar which receives the freshly harvested cabbage sooner after harvest. The cabbage is dispatched to other locations within less than 6 hours from main market of Parimpora. This practice is strictly followed by vegetable traders during hot summer months because

cold storage facilities are lacking in the whole sale markets. Time elapsed in transit and storage increases for the cabbage lots supplied to other districts which becomes the reason for higher post harvest soft rot disease in distant markets of Anantnag and Baramulla Due to this reason, least soft rot incidence and intensity was recorded at Srinagar.

Fig 1: Temperature, R.H, incidence and Severity of soft rot of cabbage in Kashmir during 2008

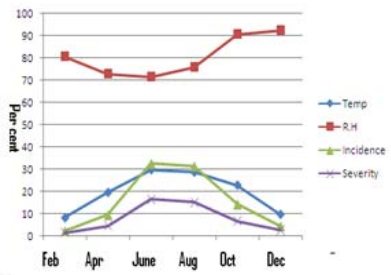


Fig-2: Temperature, R.H, incidence and Severity of soft rot of cabbage in Kashmir during 2009

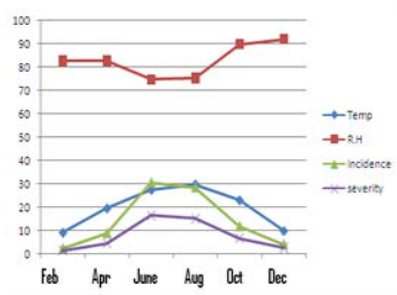
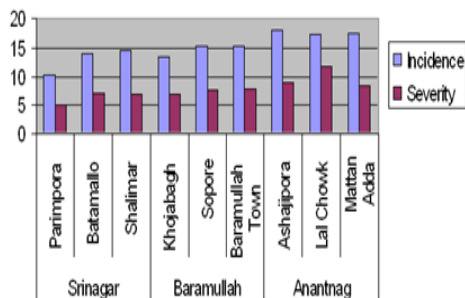


Fig. 3: Average yearly incidence and severity of soft rot of cabbage in different locations of Kashmir valley during 2008-09



Upon isolation all the isolates of causal bacterium that readily macerated the host tissue were found to be gram negative, rod shaped, facultatively anaerobic; catalase

positive, oxidase negative, urease was not produced by the bacterium and. Starch also was not hydrolyzed but the bacterium readily hydrolyzed gelatin and pectin. Optimum temperature for growth was 30°C. The bacterium could also grow at 36°C. All the pathogenic, morphological, and biochemical observations agreed with the description for *Erwinia carotovora sub-sp. carotovora* (Schaad et al, 2001) The samples were also sent to Division of Bacteriology, Indian Agricultural Research Institute (IARI), New Delhi where they confirmed our results. This bacterium had not been previously isolated from Kashmir associated with cabbage or any other crop. Soft rot of vegetables is caused by various species of *Bacillus*, *Pseudomonas* and *Erwinia* (Agrios, 2006). *Erwinia carotovora sub sp. carotovora* is, however, considered to be one of the major soft rot causing bacterium in India (CCSHAU, 2002; Larka, 2004).

Studies on host range (Table 1) of the bacterium revealed that the bacterium could macerate all the representative species of major vegetables viz., *Dacus carota*, *Cucumis sativa*, *Allium cepa*, *Solanum tuberosum*, *B. oleracea var botrytis*, and *Lycopersicon esculentum*. However, the degree of maceration varied among them after 96 hours of inoculation. The highest being in tomato followed by cucumber. The degree of maceration is more in fruits with less degree of firmness which could be due to degradation of pectin by pectinases produced by the bacterium. The host range of *E. carotovora sub spp. carotovora* has been reported as *B. chinensis* (Chinese cabbage) *B. oleracea var acephala* (kale), *Cucumis sativus*, *Delphinium ajacis* *Glycine max*, *Helianthus tuberosus*, *Lupinus sp.*, *Phaseolus vulgaris*, *Nicotiane tabacum*, (Broadbery 1986). Rajeh and Hameed (2000) also isolated *E. carotovora sub spp. carotovora* from different vegetables in Jordan. These findings are also in accordance with those of Anonymous (1990) and Walker (1998).

4. Conclusion

The incidence and severity of soft rot in cabbage is highest during summer months of June to August. The causal organism

responsible for soft rot of cabbage in Kashmir is *Erwinia carotovora* sub sp *carotovora* The organism causing soft rot disease in cabbage

has a very wide host range infecting vegetable species belonging to different major vegetable families.

Table 2: Host range of *Erwinia caratovora* subspp. *caratovora* under conditions of artificial inoculation

| Host | Botanical Name | Infectivity | Days taken to express first symptom | Soft rot intensity after 96 hours of inoculation |
|-------------|----------------------------------|-------------|-------------------------------------|--|
| Carrot | <i>Dacus carota</i> | + | Two | 20.00* (26.56) |
| Cucumber | <i>Cucumis sativa</i> | + | One | 32.00 (34.16) |
| Onion | <i>Alium cepa</i> | + | Three | 20.00 (26.56) |
| Potato | <i>Solanum tuberosum</i> | + | Two | 20.00 (26.56) |
| Knol Khol | <i>B. oleracea var caulorapa</i> | + | Two | 24.00 (29.09) |
| Cauliflower | <i>B. oleracea var botrytis</i> | + | Two | 28.00 (31.40) |
| Tomato | <i>Lycopersicon esculentum</i> | + | One | 44.00 (41.31) |

CD_(0.05)

+ = Positive reaction

*= Data presented is average of five replications

(08.67)

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