RESEARCH ARTICLE

# YIELD LOSS ASSESSMENT OWING TO ALTERNARIA BLIGHT OF FENNEL AND ITS MANAGEMENT

**Suresh Meena[1], R.P. Ghasolia[1], A.L. Yadav[2]* and Shankar Lal Yadav[1]**

*[1]SKN College of Agriculture, Jobner, Jaipur, Rajasthan-303328*
*[2]College of Agriculture, SKRAU, Bikaner, Rajasthan-334006*
*Email: yadavarjun003@gmail.com*

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**Abstract:** An effort was made to estimate avoidable loss due to Alternaria blight. Pooled analysis of two years data revealed that maximum disease intensity (82.58 %) was recorded in inoculated control with 8.63 q/ha seed yield. Two sprays of mancozeb @ 0.25 % at 14 days interval with initiation of disease was most effective and significantly reduced disease intensity (64.43 %) over inoculated control and with 92.87 per cent increased seed yield, thus showing 48.15 per cent avoidable yield loss. Single spray of mancozeb @ 0.25 % was also able to increase seed yield by 26.41 per cent.

**Keywords:** Alternaria blight, Fennel, Yield, PDI

## INTRODUCTION

Fennel (*Foeniculum vulgare* Mill.) belongs to the family *Apiaceae* is an annual, stout, aromatic herb of 100-180 cm height having slender, branched, smooth stem and alternate and decompound leaves. The inflorescence is terminal bearing compound umbel subtended by involucres of bracts. The fruit of fennel, commonly known as seed is a schizocarp of two mericaps attached to a dividing carpophore. A fully grown fruit is 4 to 8 mm long. The plant is pleasantly aromatic and each of the parts i.e., leaves, stalks, bulbs and seeds, is edible. The fish string like leaves are valued as source of flavor, garnish and also possess diuretic properties. The fennel seeds are used in curing diseases like cholera, bile disturbances, nervous disorders, constipation, dysentery and diarrhoea and also used for control of diseases attacking chest, lungs, spleen, kidney and in colic pain. In India, the seeds are also used for mastication and chewing either alone or with betel leaves (Girija Lakshman, 1952 and Agarwal *et al*., 2001). The paste of seeds is used in cooling drink in fevers, burning mictuaration and scalding of urine.

Fennel is widely accepted as a native of southern Europe. It is cultivated throughout the temperate and subtropical region in the world mainly in the countries like Romania, Russia, Hungary, Germany, France, Italy, India, Sri Lanka, Malaysia, Japan, Argentina and USA. Almost all seed spices are cultivated in India and has got the privilege to be called as the largest seed spices producing country in the world (Anonymous, 2013-14). The major fennel growing belt spreads from arid to semi-arid regions covering large area in Rajasthan and Gujarat. Total area under the crop in India is about 54,000 hectares with production of 70,000 million tonnes (Anonymous, 2014). In Rajasthan, it occupies an area of 15,160 hectares with an annual production of 14,280 million tonnes (Anonymous, 2014). It is mainly cultivated in the districts of Sirohi, Jodhpur, Nagour, Tonk, Dausa and Pali and to a limited extent in Bharatpur, Kota and Ajmer.

The ideal climatic conditions for fennel are frost free, moderately cool climate and clear sky throughout its growth and well drained, loamy or sandy loam soils are good for fennel production. However, fennel can be grown in all types of soils provided that they are rich in organic matter with good drainage.

Fennel is attacked by a number of diseases *viz*., Ramularia blight (*Ramularia foeniculi*), powdery mildew (*Leveillula taurica*), seedling damping off (*Alternaria petroselini*), root rot (*Fusarium solani*), Alternaria blight (*Alternaria alternata* and *Alternaria petroselini*). Leaf blight of fennel caused by *Alternaria petroselini* was first reported by Infantino *et al*.,2009 from Italy while in Spain it was reported by Bassimba and Mira, 2012. Alternaria blight of fennel caused by *Alternaria alternata* is a serious bottleneck in augmenting fennel (*Foeniculum vulgare*) production in Gujarat (Chaudhari and Patel, 1987). The disease manifests itself on all above ground plant parts in the form of angular, black depressed lesions on the basal leaves. Small dark spots were observed, that soon developed into necrotic areas on the fennel stalks (Infantino *et al*., 2009) which later become larger and covered with grayish white erumpent growth. With the advancement of infection, lower and older leaves defoliate, stem and peduncles are covered with rectangular spots.

Alternaria blight of fennel causes losses of different magnitudes. More than 50% of the inspected fields showed Alternaria blight symptoms on fennel with an incidence ranging from 30 to 100% in Italy (Infantino *et al*., 2009).

## MATERIALS AND METHODS

The present investigations were carried out during *rabi* 2013-14 and 2014-15 at the Agronomy Farm, S.K.N. College of Agriculture, Jobner and

*Corresponding Author

Department of Plant Pathology, S.K.N. College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Rajasthan. Jobner is situated at latitude $26^0$ 5' N, longitude of $75^0$20' E and altitude of 427 meters above MSL (mean sea level). The region falls under semi-arid eastern plain (Agro Climatic Zone- lll A) of Rajasthan.

The field was prepared before sowing by cross ploughing with tractor drawn disc harrow and planked. The field experiments were conducted on susceptible fennel local cultivar. The lay out plans of different field experiments were demarcated in the field for treatment application. After applying the treatments, the crop was sown in the last week of October in both the years except age & date of sowing experiments. The crop was raised in plots of 2m x 2m keeping row-to-row and plant-to-plant distance of 50 cm x 20 cm. The irrigation was applied as per the recommendation for the crop in this zone and one weeding and hoeing was done at 30-35 days after sowing. For keeping desired plant populations, thinning was done after 30 days of sowing.

The disease intensity was recorded as per 0-5 rating scale given by Jaiman *et al*. (2013). Randomly selected five plants from each field were rated as per following description and per cent disease intensity (PDI) was calculated by using the formula of Wheeler, 1969.

| S. No | Description | Grade |
|---|---|---|
| 1 | No incidence/ Healthy | 0 |
| 2 | Symptoms on leaf tip and leaves only | 1 |
| 3 | Symptoms on leaves and petiole | 2 |
| 4 | Symptoms on leaves, petiole and stem | 3 |
| 5 | Symptoms on leaves, petiole stem and inflorescence | 4 |
| 6 | Symptoms on leaves, stem, inflorescence including Seed | 5 |

$$PDI = \frac{\text{Sum of numerical disease rating}}{\text{No. of plants assessed x Maximum disease rating}} \times 100$$

The disease samples collected during survey were brought to the laboratory in paper bags for further studies.

**Estimation of yield loss caused by Alternaria blight**

To determine the relationship between Alternaria blight disease intensity of fennel and seed yield loss, an experiment was laid down in RBD with four replications for two consecutive years i.e. 2013-14 and 2014-15 with local fennel variety. To create plants of different infection indices, different sprays of mancozeb @ 0.25 per cent were applied. Treatments were as follows: (i) Inoculated control, (ii) One spray of mancozeb 7 DAI, (iii) One spray of mancozeb 14 DAI, (iv) Two sprays of mancozeb 7 and 21 DAI, (v) One spray of mancozeb 21 DAI, (vi) One spray of mancozeb 28 DAI, (vii) Uninoculated control (naturally infected). Plants were inoculated with conidial suspension of *Alternaria alternata* as mentioned earlier. First spray of the chemical schedule was started just after disease appearance.

Observations on disease intensity were recorded twice, first 15 days after first spray and finally 15 days after last spray, using 0-5 scale for measuring plant infection. Five plants were selected randomly from each plot and per cent disease intensity was calculated. Seed yield from each plot was recorded and yield from different disease indices were compared. Estimated loss was calculated considering maximium obtainable yield by two sprays of mancozeb @ 0.25 % at 7 and 21 DAI where percent disease intensity remained minimum. The percent estimated loss in grain yield was calculated over inoculated control with the following formula.

$$\text{Percent estimated loss in yield} = \frac{\text{Yield of plants protected with fungicide} - \text{yield of control}}{\text{Yield of plants protected with fungicide}}$$

**RESULTS**

**Estimation of yield loss**

Seed yield loss due to Alternaria blight of fennel was studied by inoculating the fennel crop with *A. alternata* and crop was protected by giving one spray of mancozeb (0.25 %) at 7, 14, 21, and 28 days and two spray of mancozeb (0.25 %) at 14 days interval with uninoculated control (naturally infected).

Pooled analysis of data for 2013-14 and 2014-15 (Table 1) revealed that inoculated plant gave 82.58 per cent disease intensity whereas 77.48 per cent disease intensity was observed on naturally infected plants without any control measures indicating that more disease can be created by inoculating the plants at right stage. By application of treatments disease was not completely avoided however different treatment showed significant reduction in Alternaria blight.

Two spray of mancozeb (0.25 %) at 14 days interval (i.e. 7 and 21 DAI) were found most effective and significantly reduced Alternaria blight by 64.43 per cent with lowest (29.37 %) disease intensity (Table 1). One spray of mancozeb (0.25 %) at 7 and 14 days after inoculation was also significantly reduced disease intensity by 30.90 and 38.67 per cent over inoculated control but significantly inferior over two sprays of manozeb (0.25 %) at 14 days interval. Plants when sprayed at 21 and 28 days after inoculation, gave higher disease intensity (44.41 and 51.96 %, respectively).

Pooled analysis of grain yield data for 2013-14 and 2014-15 (Table 1.) revealed that two spray of mancozeb (0.25 %) at 14 days interval (i.e. 7 and 21 DAI) gave better seed yield (16.64 q/ha) over inoculated control (8.63 q/ha.) A single spray of mancozeb at 7, 14, 21 and 28 days after inoculation was also significantly increased seed yield over inoculated control and uninoculated control.

Even single spray of mancozeb (0.25 %) was able to increase yield by 26.41 - 66.49 per cent. Single spray of mancozeb (0.25 %) applied at 7, 14, 21 and 28 days after inoculation resulted in avoidable losses of 13.70, 24.27, 25.24 and 34.43 per cent, respectively whereas two spray at 14 days interval after inoculation resulted in 48.15 per cent avoidable loss due to Alternaria blight of fennel.

**Table 1.** Estimation of avoidable losses due to Alternaria blight of fennel and seed yield

| Treatments | Per cent disease intensity* | | | Decrease in PDI over inoculated control (%) | Yield (q/ha)* | | | Increase in yield over inoculated control (%) | Avoidable loss (%) |
|---|---|---|---|---|---|---|---|---|---|
| | 2013-14 | 2014-15 | Pooled | | 2013-14 | 2014-15 | Pooled | | |
| Inoculated control | 81.49 (64.52) | 83.67 (66.17) | 82.58 (65.34) | - | 9.40 | 7.85 | 8.63 | - | - |
| One spray of mancozeb 7 DAI | 29.68 (33.01) | 32.12 (34.52) | 30.90 (33.77) | 62.58 | 14.92 | 13.80 | 14.36 | 66.49 | 13.70 |
| One spray of mancozeb 14 DAI | 36.92 (37.42) | 40.42 (39.48) | 38.67 (38.45) | 53.17 | 13.38 | 11.82 | 12.60 | 46.09 | 24.27 |
| Two spray of mancozeb 7 & 21 DAI | 28.49 (32.26) | 30.25 (33.37) | 29.37 (32.81) | 64.43 | 17.15 | 16.12 | 16.64 | 92.87 | 48.15 |
| One spray of mancozeb 21 DAI | 43.36 (41.18) | 45.45 (42.39) | 44.41 (41.79) | 46.22 | 13.21 | 11.66 | 12.44 | 44.17 | 25.24 |
| One spray of mancozeb 28 DAI | 50.92 (45.53) | 53.00 (46.72) | 51.96 (46.12) | 37.07 | 11.21 | 10.62 | 10.92 | 26.41 | 34.43 |
| Uninoculated control (natural infection) | 76.49 (61.00) | 78.48 (62.36) | 77.48 (61.75) | 6.17 | 10.12 | 9.40 | 9.76 | 13.09 | |
| SEm+ | 2.04 | 2.08 | 2.05 | | 0.53 | 0.5 | 0.52 | | |
| CD (p=0.05) | 6.28 | 6.40 | 6.31 | | 1.64 | 1.57 | 1.61 | | |

*Average of three replications

Figures in parentheses are angular transformed values DAI = Days after inoculation

## DISCUSSION

Fennel (*Foeniculum vulgare* Mill.) is an important seed spice crop of India. An effort was made to assess the grain yield loss due to Alternaria blight disease. Two sprays of mancozeb (0.25 %) starting from disease initiation and repeated after 15 days of first spray resulted in yield increase of 92.87 per cent over inoculated control. Grain yield loss of 48.15 per cent can be avoided if proper control of the disease is made by use of fungicides. Although 100 per cent control could not be achieved. The results are in conformity with Datar and Mayee (1981) they reported that early blight caused by *Alternaria solani* having coefficient of disease index of 71.66 per cent could cause losses up to 78.51 per cent in tomato fruit yield. Saha and Das (2012) have also recorded higher yield loss (38.15%) in ARTH- 128 variety of tomato due to early blight attack.

An effort was made to estimate avoidable loss due to Alternaria blight. Pooled analysis of two years data revealed that maximum disease intensity (82.58 %) was recorded in inoculated control with 8.63 q/ha seed yield. Two sprays of mancozeb @ 0.25 % at 14

days interval with initiation of disease was most effective and significantly reduced disease intensity (64.43 %) over inoculated control and with 92.87 per cent increased seed yield, thus showing 48.15 per cent avoidable yield loss. Single spray of mancozeb @ 0.25 % was also able to increase seed yield by 26.41 per cent.

Although, with the application of two sprays of mancozeb @ 0.25 % after disease initiation, complete control of Alternaria blight of fennel could not be achieved but 48.15 per cent loss could be prevented.

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