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RESEARCH ARTICLE

Nutrient Supplement Efficacy Against Powdery Mildew of Pumpkin (*Sphaerothecafuliginea*) and Its Correlation with Environmental Factors

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Abstract

Nutrient supplementcan enhance resistance in pumpkin (*Cucurbitapepo* L.) against powdery mildew infection. Current study was an effort to determine effect of mono-potassium phosphate and potassium silicate on powdery mildew on pumpkin and environmental conditions conducive for development of disease. A susceptible variety (Mahadeev) was sown under RCBD.Three sprays of 1% nutrient solution (mono-potassium phosphate and potassium silicate) and their combination were sprayed on pumpkin plants before inoculation of spore suspension at 7 days interval and compared with control under field conditions. Combine effect of mono-potassium phosphate and potassium silicate (33.59%) expressed minimum disease incidence followed by potassium silicate (38.87%) and of mono-potassium phosphate (44.33%) as compare to control (75.65%). There was overall positive correlation between disease incidence and maximum, minimum temperature and relative humidity while wind speed and rainfall showed negative correlation.

Introduction

Pumpkin (*Cucurbitapepo* L.) is a major fresh vegetable export of Pakistan. In Pakistan the total area of pumpkin cultivation is near about 26 thousand hectares with the 43, 995 tons of production (GOP, 2010). Worldwide production area of pumpkin is more than 220 million tons (FAOSTAT, 2012). They are widely grown and consumed in many tropical and subtropical countries around the world (Jun *et al.*, 2006). Pumpkin crop effect by many insect pests includes aphids; pumpkin beetle (*Aulacophorahilarus*). There are three important mosaic viruses that affect pumpkins zucchini yellow mosaic virus, papaya ring spot virus leads to damage the pumpkin. Other diseases include bacterial leaf spot (*Xanthomonascampestris)* and Fusarium foot rot (*Fusariumsolani*). Foliar disease like downy mildew (*Pseudoperonosporacubensis*) and especially powdery mildew (*Sphaerothecafuliginea*) damage the crop. Powdery mildew disease is one of the most serious plant diseases, causing large yield losses in a number of crops (Kiss, 2003) Powdery mildew is a wide distributed and destructive disease of pumpkin in most areas of the world and can be a major production problem of yield losses 30-50% of cucurbit (El-Naggar *et al.*, 2012). Disease reported on other cucurbits in the plains of Pakistan. Powdery mildew reduces the photosynthetic rate, severe infections may kill the plant (Queiroga *et al.*, 2008). Chemicals are also used as a control method. It is easy, direct and repaid action and easy to solve the disease problems. However, continues reliance on chemical control has proven increasingly by unsuitable in reality a great problem for disease management such as environment problem and degradation (McGrath, 2001). Foliar application of fertilizer for induction of plant resistance has been investigated by various host-pathogen interactions (Kuc, 1995). The effective nutrients supplements require the knowledge of epidemiology of disease because it's provided the forecasting disease outbreaks. Similarly (Rossi *et* *al.*, 2000) reported important epidemiological parameter for powdery mildew outbreaks strongly dependent on weather factors.

Keeping in view, the research plan was designed to investigate the potential of nutritional supplements for disease management and correlation with environmental factors to adopt the innovative ways to improve the consistency against powdery mildew disease.

MATERIALS AND METHODS

The field experiment was conducted during 24 Feb 2012. Pumpkin variety (Mahadeev) seed were taken from vegetable section from AARI, Faisalabad. Pumpkin was direct seeded on a plot of 54 × 29 feet in research area of Department of Plant Pathology University of Agriculture. All agronomic practices were followed to maintain the Pumpkin field.

*S. fuliginea*obtained from pumpkin plants grown in a growth chamber. Inoculum was obtained from freshly sporulating infected leaves 9-12 days after inoculation. Conidia were gently brushed into 100 ml distilled water containing two drops of Tween-20 and counted with the aid of a haemocytometer to give a suspension of 4×10^4 conidia/ml. For inoculation, the upper surfaces of all the leaves were sprayed with a conidial suspension delivered by a hand sprayer.

For the management three sprays of 1% nutrient solution of mono-potassium phosphate and potassium silicate and their combination were sprayed on pumpkin plants before inoculation of spore suspension at 7 days interval and compared with control. Data regarding disease incidence was recorded one day before each spray. Disease incidence was calculated with following formula:

$$\text{Disease incidence (\%)} = \frac{\text{No. of infected plant}}{\text{Total number of plant}} \times 100$$

To determine the relationship of powdery mildew of pumpkin with environmental conditions data regarding disease incidence was taken at weekly interval. Environmental data (maximum and minimum temperature, rainfall, relative humidity and wind speed) was obtained from Meteorological section, Department of Crop Physiology, University of Agriculture, Faisalabad.

Data analysis

Data was subjected to statistical analysis using randomized complete block design (RCBD) and ANOVA was used to determine the effect of nutrients on powdery mildew. Relationship of powdery mildew with environmental conditions was determined by correlation regression analysis (Steel, 1997).

Results

Evaluation of nutrient supplements under field condition against powdery mildew of pumpkin

All the nutrients and their combinations used for reduction inpowdery mildew highly significant results. Mean value of combine effect of PMK+PSI (33.59%) showed that it was most effective for reduction in disease incidence followed by PSI (38.87%) and MPK (44.33%) as compare to control (75.65%). The significant results of effect of different nutrients and their combinations for reduction in powdery mildew incidence can also be observed (Fig.1).

Relationship of environmental conditions with mildew of pumpkin incidence

There was overall positive correlation between disease incidence and maximum, minimum temperature and relative humidity while wind speed and rainfall showed negative correlation (Table 1). Maximum incidence of powdery mildew was observed at air temperature 34-35^{o}C and 18-19^{o}C, maximum and minimum temperature respectively (Fig.2 and Fig.3). At these temperature incidence of PM continued to increase. Incidence of powdery mildew was recoded low when temperature decreased from 35^{o}C (Fig.3). So 34-35^{o}C was found to be optimum Temperature for the development of powdery mildew. Rainfall and wind speed was negatively correlated with powdery mildew incidence maximum disease incidence was observed at 0 mm rainfall and 4.4 Km/ha of wind speed. This relationship is also explained by linear regression model (Fig. 5 and Fig. 6). Relative humidity expressed very week correlation with development of powdery mildew of pumpkin (Fig. 6).

Table 1. Correlation of environment factors with Pumpkin powdery mildew disease on pumpkin

Sr. No	Variety	Temperature (^oC)		Relative humidity (%)	Rainfall (mm)	Wind Speed (km/h)
		Max.	**Min.**			
1	**Mahadeev**	0.94520 <.0001	0.84083 <.0001	0.22311 <.0001	-0.86665 <.0001	-0.95996 0.0049

Discussion

This study demonstrated that simple compound, such as (KH_2P0_4) and (K_2SiO_3) have a potential for controlling powdery mildew of field grown pumpkin. Foliar application of mono potassium phosphate + potassium silicate inhibits the disease development. These results are supported by the findings of (Nofal and Haggag, 2006). Disease was suppresseddue to the inhibitory effects of potassium and phosphate salt. (K_2SiO_3) was supplied to pumpkin plant via foliar nutrient solution the inhibition of pathogen clearly observed as to compare with control plant. Potassium silicate has protective mechanisms induced resistance against powdery mildew by biosynthesis of phytoalexins (Yu *et al.*, 2010).

It is generally accepted that germination of conidia of *S. fuliginea*occurs between 15^{o}C and 30°C, and is greatest at 25°C (Manners and Hossain, 1963). Conidia germinate best at relative humidity of 97-100% (Cheah *et al.*, 1996), but not below, indicating that they require moist air to germinate. Spore germination decreased or was delayed in the presence of free water ourfinding conformed by demonstrated (Willocquet *et al.*, 1998). Powdery mildew symptoms appear first on leaves under dense canopies where relative humidity is usually high. It has also been reported that cucurbit powdery mildew develops better in shade than in the full sunlight (Willocquet and Clerjeau, 1998). There is general agreement that young leaves of cucurbits are more resistant to powdery mildew than older leaves (Cheah *et al.*, 1996). Our field observations indicate that the disease does not appear on pumpkin until air temperatures arise above 20°C. The disease spreads rapidly during hot period. The best favorable conditions for disease development are 35^{o}C and over 70% RH. These results are in agreement with previous reports regarding powdery mildew influence on environmental factors (Lebeda and Cohen, 2011).

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