USE OF SOIL AMENDMENTS TO CONTROL BACTERIAL WILT DISEASE IN POTATO

By

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B.Sc.,Agric.Sc.(Plant Pathology), Ain Shams University , 2003

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ABSTRACT

Mohamed Hamed El-Sayed Mahmoud Hagag: Use of Soil Amendments to Control Bacterial Wilt Disease in Potato. M.Sc. Thesis, Plant Pathology Department, Faculty of Agriculture, Ain Shams University, 2015.

All tested isolates were typical identified as *Ralstonia solanacearum* according to morphological, cultural, physiological and biochemical characters. Also, these isolates gave positive reaction with indirect immuno-fluorescent (IF) and polymerase chain reaction (PCR) and were found to belong to biovar 2. Application of chemical amendments (Urea, Ammonium nitrate and ammoniated superphosphate) and organic amendments (Garlic, Cabbage and camphor, dry leaves) individually or their mixing reduced severity of potato wilt under greenhouse and field experiments compared to the control. Efficiency of tested amendments increased with increasing their application rates. In greenhouse experiments, chemical amendment was more effective than organic ones in disease control individual though mixing treatments was more effective than their individual applications. Meantime, urea as chemical amendment and dry garlic leaves as organic amendment either individual or after mixing, were the most effective. Under field conditions, the population of *R.solanacearum* in rhizosphere, crown, and potato tubers, along with severity of wilt were decreased and the potato yield was increased with mixing chemical and organic amendments compared to control. Mixing urea and dry garlic leaves was the most effective to reduce population of *R.solanacearum* and to increase the yield, but other mixing applications were moderately effective.

Key words: chemical and organic amendments, potato diseases, *Ralstonia solanacearum.* Urea, Ammonium Nitrate, Super Phosphate, Garlic, Cabbage, Camphor.

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INTRODUCTION

Potato Bacterial wilt disease caused by *Ralstonia solanacearum* phylotype II sequevar I **(Tomlinson *et al,* 2011)** is one of the important quarantine plant diseases as listed in A2 European Plant Protection Organization **(EPPO, 2004)** during exportation**.** Potato is one of the four worldwide major food crops after wheat, maize and rice. Integrated pest management (IPM) is the important approach in sustainable agricultural development, which have a role in reducing the crop losses, increasing productivity and minimizing contamination and health hazards **(Nwilene *et al,* 2008).**

Urea (200kg/ha), calcium oxide CaO (2t/ha), cowdung (10t/ha) and poultry manure (10t/ha) were used as soil amendment in field which affect the incidence of bacterial wilt **(Kelaniyangoda *et al,* 1997).** Urea (200 kg of N per ha) and CaO (5000 kg/ha) suppressed the survival of *R. solanacearum* **(Michel and Mew, 1998).** Mixing urea and calcium oxide at the rate of 80: 800 kg/rai reduced the artificial infested soil with 2.83×10^7 CFU/ml of *R.solanacearum* bacteria **(Vudhivanich, 2002).** The effects of amending topsoil with three different levels (1, 5 and 10%) of Cocopeat, farmyard manure (FYM) compost and green compost were used to control bacterial wilt **(Yadess *et al,* 2010).** Different doses of Gypsum were tested on disease severity of *R.solanacearum* **(Ajjappalavara *et al,* 2008)**. Use of NPK fertilization **(Messiha *et al,* 2007),** Compost-amended **(Ogai *et al,* 2009 and Alvarez *et al,* 1994),** Mushroom compost **(Chellemi *et al,* 1992)** and Leaf juices of hemp-agrimony (*Eupatorium cannabinum*) have shown a good result against soil borne diseases **(Kumar and Tripathi, 1991).** Cruciferous plants as soil biofumegants **(Gamliel and Stapleton, 1993)**, Ammonium sulfate, potassium sulfate, Urea and dried leaves of cabbage, camphor and garlic were used to control bacterial wilt in potato **(Abd El-Ghafar and Abd El-Sayed, 2002).** Camphor (*Cinnamomum camphora*) was used as soil fumigant **(Chen *et a,*. 1988).** Essential oils namely thyme, camphor,

caraway and lemon oils were tested against *R. solanacearum* **(Farag, 2013).**

The use of composts to supress soilborne plant pathogens has been extensively reviewed by several authors **(Deceuster and Hoitink, 1999; Mikhail *et al*, 2005 and Youssef, 2007)** processed compost is used to develop marginal soils for crop production, and revegetate wasted and disrupted lands, prepare potting mixes, improve existing crop land, stimulate growth and suppress disease caused by soil-borne plant pathogen **(Hoitink and Fahy, 1986 and Mays and Giordano, 1989).** Application of organic amendments is an effective measure for controlling soil-borne disease **(Farag, 1976; Baker, 1981; Huang and Huang, 1993 and Abd El-Ghafar *et al*, 2004)**. Bacterial wilt in tomato was supressed in the poultry and farmyard manure added soil and higher microbial activity was likely responsible **(Farag, 1976; Islam and Toyota, 2004).** The suppression or enhancing effect of composts depend on their chemical and biological composition **(Litterick *et al*, 2004)** as well as on the pathogen involved **(Termorshuizen *et al*, 2006).**

The aim of this study was to isolate the causal organism from different samples collected from different governorates and it identified using traditional and modern methods. Also, some chemical and organic amendments individually or in combination were applied for controlling potato bacterial wilt disease under greenhouse and field conditions, and thier effects on growth parameters of potato plants.

REVIEW OF LITERATURE

1- The Host, Potato, *Solanum tuberosum*

1-1- Origin and classification

The potato is an important tuberous crop and one of the four worldwide major food crops after wheat, maize and rice. Potato is native to South America then was transported and dispread to Europe by Spanish discovers then became one of main crops in Europe. Potato one of crops which has had a strong impact on the destiny of Irish people **(Abd El-Moneam, 1999)**. Potato is an annual dicotyledonous plant that belonging to the Family, Solanaceae, Genus: Solanum. Wild potato species was reported in 16 countries, 88% of them in Argentina, Bolivia, Mexico, and Peru **(Robert and David, 2001).**

1-2- Global production

Total world production reached to 368 million tons in 2013. China is the largest producers of potatoes in the world, where produce 88.9 million tons in 2013 then India 45.3 million tons **(FAO stat, 2013).**

1-3- Production and exportation in Egypt.

Egypt ranked 14th country among the top potato producers worldwide **(FAO stat, 2013)** where produce 4.8 million tons in 2013. Potato entered Egypt during the reign of Muhammad Ali was not grown before. Second vegetable crop recorded for exportation after oranges.

Potato exportation was fluctuated increasing and decreasing Egypt's production of potatoes in 2011 reached to 464 thousand tons its values up to 1.5 billion pounds, reduced this production in 2012 to 287.6 thousand tons then returns grow up again to 678.62 thousand tons in 2014 Potato Brown Rot Project **(PBRB, 2014).**

1-4- Potato diseases

Many of pathogenic agents infect potato, 38 species of fungi, 6 of bacteria, 68 of nematode, 128 of insects and mites, 23 viruses, 2 of mycoplasma, and one viroid are the most dispread in the world. The most famous diseases which cause problems in Egypt are (Early blight *Alternaria solani*, late blight *Phytophthora infestans*, Rhizoctonia canker

Rhizoctonia solani, and Verticillium wilt *Verticillium dahlia*) as fungal diseases, Bacterial wilt or brown rot *Ralstonia solanacearum* as a bacterial diseases, PVX, PVY, and PLRV as viral diseases **(Abd El-Moneam, 1999).**

2- *Ralstonia solanacearum* the pathogenic bacteria.

R.solanacearum has a very diversity host range, geographic distribution, physiological properties, and genetic diversity, which impose a challenge for its nomenclature and taxonomy **(EPPO, 2004).**The first name assigned was *Bacillus solanacearum*, then *Pseudomonas solanacearum* **(Kelman, 1953)**, *Burkholderia solanacearum* **(Yabuuchi *et al,* 1992),** and finally *Ralstonia solanacearum* **(Yabuuchi *et al,* 1995)**. The bacterium was classically divided into 5 races and 6 biovars **(Buddenhagen *et al,* 1962; Hayward, 1964)** and recently the sequence of 16S-23S rRNA was used to phyllogentically divide it into 4 phylotypes, and the sequence of endoglucanase, hrpB, and ITS region used to divide it into sequevars **(Fegan and Prior, 2005).** In Egypt race 3 biovar (phylotype II sequevar 1) is the dominant race **(Tomlinson *et al,* 2011).**

2-1- General description around the pathogen- :

Ralstonia solanacearum is gram negative, aerobic-Chemo-organotrophic rod with rounded ends and does not form spores capsules **(Kelman, 1953; Shekhawat *et al,* 1992).** The bacterial cells are motile but conflicting reports exist as the number of flagella present on a single cell. According to Berg's manual of determinative bacteriology **(Holt *et al*., 1994)** more than one flagellum occur, while authors such as **(Shekhawat *et al,* 1992)** described virulent isolates as non-motile and non-flagellate four polar flagella. Depending on the strain, the optimum temperature for growth varies between 27-37oC with maximum temperatures of approximately 39°C and 10 to 15°C respectively .

2-2- Pathogen classification:-