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Asian Journal of Plant Science and Research, 2016, 6(2):13-17

ISSN : 2249-7412
CODEN (USA): AJPSKY

Host resistance and reduced fungicide application for management of potato late blight (*Phytophthora infestans*) in South west Ethiopia

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ABSTRACT

Trial was carried out in March 2015 at dedo district, South West Ethiopia to test host resistance and reduced fungicide application for management of late blight. In this experiment four improved and one local potato varieties were used. RCBD with seven replications were established. A recommended rate of Ridomil-gold WP 65% fungicide was applied while susceptible local variety developed the first blight symptom. GLM procedures were followed to analyze yield, yield components, disease incidence and severity. LSD (P<0.05) values were used to separate treatments mean. Number of tubers per plant, weight of tubers per plant, total weight of tubers per plot and weight of marketable tubers per plot were show significant difference (P<0.01) among treatments. The highest number of tuber per plant was scored by variety Jalene (13.6). Bubu and local varieties scored the least (10.07 and 10.47) respectively. Variety belete gave the highest weight of tubers per plant (1.37 kg) where as local variety gave the least (0.7 kg). Local variety scored lower total weight of tubers per plant and marketable tubers per plot (31.53 and 26.03 kg). Variety belete scores the highest total weight of tubers per plant and marketable tubers per plot (61.77 and 58.22 kg). Local potato variety also gave the highest unmarketable tubers weight per plot. The result indicated that there were a significant difference (P<0.05) among treatments on late blight incidence and severity. Local variety showed highest late blight incidence and severity as compare to variety belete. The experiment result suggested that application of Ridomil-gold WP 65% once on variety belete results in significant reduction on late blight progress, with a corresponding increased tubers yield.

Key words; host resistance, late blight incidence, belete variety, Ridomil-gold

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INTRODUCTION

Potato (*Solanum tuberosum L.*) is the most important crop in developing countries and its production is expanding more rapidly than other crops [1], [2]. It is becoming an important source of rural employment, income and food for ever growing populations. The crop is the fourth major crop of the world next to rice, wheat and maize [3].

Potato was introduced to Ethiopia in the 19th century by a German Botanist Schimper [1], [4]. It is grown by approximately 1 million farmers [5]. The crop is considered as a high-potential food security crop because of its ability to provide a high yields per unit input with a shorter crop cycle (< 120 days) than major cereal crops like maize [6].

Ethiopia is among the top potato producers country in Africa, about 70% of its arable land in the high altitude (1500 mas) being suitable for potato production [7], [8]. Even though the country has huge potentials for potato production only smaller portion of the arable land is covered by the crop. Only 80,000 hectares is under potato cultivation. The main reason associated to this under utilization of the crop is the narrow genetic base and most of the people use

cereals as staple food. In addition to this, lack of high yielding and disease resistant varieties, insect and diseases problem are also the main challenges.

Potato late blight caused by *Phytophthora infestans* is the major production constraints in Ethiopia. The disease is a serious production constraint in major potato growing areas of African especially in Kenya and Ethiopia. [9] Reported that the disease causes 100% yield loss on unimproved local cultivar and 67.1% on a susceptible variety. Management of potato crop against this pathogen is important to maximize the yield. The disease occurs throughout the major potato and tomato production areas and it is very challenging to produce both crops during the main rainy season without chemical protection measures [10], [11]. Although fungicides have been used to manage late blight, both the efficacy and availability of commonly used fungicide have been threatened [12]. In addition to this resource poor growers could not afford an ever increasing fungicide. Combining host resistance with reduced fungicide application will be an option to manage the disease. Therefore, the aim of the research was to show the effects of integrating host resistance and reduced fungicide application for management of potato late blight disease.

MATERIALS AND METHODS

Treatments and experimental design

The study was carried out in Dedo district, Jimma Zone Oromia Regional State located at about 350 km south west of Addis Ababa. The area receives an annual average rainfall of 1000 mm during the main rainy seasons. The temperature of the zone varies between 8 to 28°C with an annual average of 20°C. It has a sub-humid, warm to hot climate.

Four relatively late blight resistance improved Irish potato varieties were collected from Holleta agricultural center (Jalene, Gudene and Belete) and Haromya University (Bubu). A susceptible local control potato variety was purchased from the local farmer and planted in March 2015. Randomized complete block design with seven replications were set up. Each plot consists of five rows (4m x 3 m dimensions) with spacing of 75 cm by 35 cm between rows and within plants respectively. A total of 35 (5x7) experimental plots were established. All management practices were done per crop requirement. Recommended rate (2.5kg/ha) of fungicide, Ridomil-gold WP 65% was once applied while local potato variety show the first blight symptom (38 days post planting). At physiological maturity stage 15 potato plants per plot were randomly selected from the middle three rows and yield and yield components data were taken.

Disease development

Incidence and severity; the experiment site is known by frequency late blight outbreak as a result natural inoculation was considered as a source. Each plant within the plots was carefully visually inspected per week for late blight incidence and severity.

The percent of incidence was calculated as;

$$\text{Disease incidence} = \frac{\text{Number of diseased plants}}{\text{Total number of plants assessed}} \times 100$$

Disease severity was assessed based on interval scales (0-4) as described by [13]. Where 0= no infection, 4= complete infection of the plant leaf.

Data analysis

Data on yield, yield components and disease parameters such as incidence and severity were analyzed following GLM procedures using Statistical Analysis of System (SAS) version 9.1software. Fisher's protected Least Significant Difference (LSD) values were used to separate differences among treatments means ($P<0.05$). Both late blight incidence and severity data was log transformed and then analyzed following GLM procedures.

RESULTS

Yield and yield components

Results of analysis of variance of the yield and yield components for four improved and one local potato varieties were presented in table 1. Number of tubers per plant, weight of tubers per plant (kg), total weight of tubers per plot (kg) and weight of marketable tubers per plot (kg) were show significant difference ($P<0.01$) among treatments.

The observed significant differences among treatments agronomic traits reveal the presence of genetic variability of the tested potato varieties. The highest number of tubers per plant was given by variety Jalene (13.6) followed by Belete and Gudene variety (11.58 and 11.74) respectively. Both Bubu and local varieties gave the least number of tubers per plant (10.07 and 10.47) respectively (Table 2). Variety belete gave the highest weight of tubers per plant (1.37 kg) where as local variety gave the lowest weight of tubers per plant (0.7 kg). Local variety (control) also scored the least on both total weight of tubers per plant as well as marketable tubers per plot (31.53 and 26.03 kg) respectively. On the other hand variety belete scored the highest results on both total weights of tubers per plant as well as marketable tubers per plot (61.77 and 58.22 kg) respectively (Table 2). Local potato variety also gave the highest unmarketable tubers weight per plot (data not shown).

Late blight incidence

Late blight disease was noticed in the cropping season while the experiment was conducted. Susceptible local variety developed the first late blight symptom 38 days post planting. A recommended rate (2.5 kg/ha) of Ridomil-gold WP 65% fungicide was applied during this time.

Analysis of disease incidence indicated that there were significant differences ($P<0.05$) among treatments (table 1). The maximum late blight incidence was recorded on the susceptible local potato variety followed by variety Jalene (table 2). Report also indicated that variety Jalene loss its resistance to late blight. Variety belete and gudene scored the least late blight disease incidence. Almost no disease incidence was scored on variety bubu (Table 2).

Late blight severity

The disease reached its peak level 58 days post planting (about 3 weeks after first symptom appearance).Treatments show a significant difference ($P<0.001$) to late blight severity (Table 1). The maximum late blight severity was recorded on susceptible local potato variety and followed by variety jalene. Local variety developed a complete leaf infection and correspondingly decreased both weight of tubers per plant and marketable tubers per plot (table 2).The remaining three potato varieties such as belete, bubu and gudene scored the lowest late blight severity (Table 2). The disease severity score ranges from 0.04 to 1.58 for belete and local potato variety respectively (Table 2).

Table 1. Significances of mean square values for six agronomic traits of four improved and one local Irish potato variety

Source of variation	Df	N= 35					
		Number of tubers /plant	Weight of tubers/plant (kg)	Total weight of tubers/ plot	weights of marketable tubers/plot (kg)	Incidence of late blight (%)	Severity of late blight (%)
Replication	6	16.78**	0.42**	861.62**	920.89**	1.22*	0.28*
Treatments	4	39.51**	1.19**	2415.53**	2851.53**	1.10*	0.37**
Error	24	2.17	0.07	144.25	181.98	0.001	0.002
CV (%)		12.81	25.29	25.46	30.05	18.45	36.90

*ns, not significant at P< 0.05, * significant at P<0.05, ** significant at P<0.001*

Table 2. Mean value of yield, yield components, late blight incidence and severity of five potato varieties

treatments	Number of tubers/plant	Weight of tubers/ plant (kg)	Total weight of tubers/ plot	weights of marketable tubers/plot (kg)	Incidence of late blight (%)	Severity of late blight (%)
Local	10.46c	0.70c	31.53c	26.03c	5.78a	1.58a
Jalene	13.60a	1.04b	46.97b	46.77b	2.40b	0.75b
Gudene	11.74b	1.04b	46.88b	46.54b	0.22c	0.082c
Bubu	10.07c	1.08b	48.66b	46.83b	0.00c	0.00c
Belete	11.58b	1.37a	61.77a	58.22a	0.12c	0.04c
CV (%)	12.81	25.29	25.46	30.057	18.45	36.90
LSD	0.90	0.1627	7.3708	8.2789	0.8052	0.2266

**Means with the same letters in each column are not significantly different at P< 0.05 LSD.*

DISCUSSION

Occurrence of late blight in sub-sharan Africa has been closely related to the introduction of susceptible varieties. In Ethiopia, potato late blight has been a serious problem since the introduction of the crop. Between 1987 and 2006, 18 potato varieties were released in Ethiopia [14]. All these cultivars came from potato germplasm introduced by the CIP as resistance varieties to *P. infestans*. Resistance to late blight in these cultivars has been overcome and significant yield losses experienced [14]. In this experiment significant variations were observed among susceptible

and resistance varieties in terms of total and marketable tubers yield (Table 2). According to [15], [16] potato yield loss attributed primarily to late blight is dependent on variety susceptibility or tolerance/ resistance and disease management practices. In our experimental trial the highest marketable tubers yield was gain when resistance host (belete variety) combined with Ridomil- gold WP 65 % fungicide application (Table 2). The present study result was in line with [17], which suggested that integration of host resistance and fungicide application reduced the late blight severity by more than 50 % and results in yield gains of more than 30%. The local control potato variety is highly susceptible to late blight and early infection (first blight symptom appeared at 38 days post planting) which results in reduced total yield and lower marketable tubers weight (Table 2). Report indicated that complete suppression of yield in susceptible variety is possible if the disease occurs early in the season. [18], [19]

CONCLUSION

The present study suggested that integration of resistance host (belete potato variety) with Ridomil-gold WP 65% fungicide results in reduced late blight disease progress, with a correspondingly increased total and marketable tubers weight. Integrated effects of host resistance and reduced fungicide application were not only gave higher yield and reduced disease progress on potato but also lower cost of production for resources poor farmers and environment pollution risk. In addition to this significantly reduced the possibility of development of chemical resistance pathogen strain. Many report indicated that frequent applications of fungicides results in the development of a new virulent strains of the pathogen.

Acknowledgment
The author expresses profound appreciation to Jimma University, College of Agriculture and Veterinary Medicine for funding the research work. The author also wants to say thanks a lot to jimma university CASCAP project for provision of transportation.

REFERENCES

[1] Horton D, and Sawyer RL. The potato as a world food crop, with special reference to developing areas. Potato physiology, London, A cademic, In Li PH, ED, **1985**, press 1-34
[2] Scott G, Rosegrant M, Tingler C. **2000**. Roots and tubers for the 21st century. International food policy research institute and international potato center. Washington DC
[3] International Potato Center (CIP). **1984**. Potatoes for the developing countries, Lima, Peru. 150
[4] Pankhurst R. 1964. Notes for a history Ethiopia agriculture. Ethio. Observer 7, 210 - 240
[5] Central Statistical Agency (CSA). **2009**. Agricultural sample survey: report on area and production of crops. Addis Ababa, Ethiopia 126.
[6] Bekele B, Abate E, Asefa A, Dickinson M. **2011**. *Journal of Plant Pathology* 93, 149-157
[7] Food and Agriculture Organization (FAO) FAOSTAT. **2008**
[8] Yilma S. **1991**. *Actae Horti* 270, 389 - 394.
[9] Bekele Kassa and Yaynu Hiskias. **1996**. Tuber yield loss assessment of potato cultivars with different level of resistance to late blight.pp. 149-152. In: Eshetu, Bekele, Abdurrahman Abdullah and Aynekulu Yemane (Eds). Proceedings of the 3rd annual conference of crop protection Society of Ethiopia 18-19 May, Addis Ababa Ethiopia, CPSE, and Addis Ababa.
[10] Abraham Tadesse. **2009**. Increasing crop production through improved plant protection Vol. II. Plant Protection of Ethiopia and Ethiopia institute of agricultural research. Addis Ababa, Ethiopia.
[11] Mesfin. **2009**. Review of research on diseases of root and tuber crops in Ethiopia. In; Abraham Tadesse Ed. crop production through improved plant protection. Addis Ababa, Ethiopia; Plant Protection of Ethiopia, 169-230
[12] Kirk WW, Felcher K.J, Douches DS, Coombs J. **2001**. *Plant Disease* 85, 1113- 1118
[13] Horsfall J, Heuberger J.**1942**. *Phytopathology* 32, 226-232
Horton D.1987. Potatoes: production, marketing and programs for developing countries. West view press. Boulder
[14] Woldegiorgis G, Gebre E, Lemaga B. **2008**. Potato breeding. In; Woldegiorgis G, Gebre E, Lemaga B, Eds. root and tuber crops, the untapped resources. Addis Ababa, Ethiopia; Ethiopian Institute of Agricultural Research 15-32
[15] Bradshaw NJ. **1992**. *Aspect of Applied Biology* 33, 101-106
[16]Thind, T.S, Chander-Mohan, J. S, Bedl, R. K, Grewal, Sokhi, S. S. **1989**. *Plant Disease Research* 4,113-117
[17] Kankwatst P, Adipala E, Hakiza JJ, Olanya M, Kidanemariam HM. **2002**. *Journal of Phytopathology* 150, 248-252
[18] Fry WE, Shtlenberg D. **1990**. *Canadian Journal of Plant Pathology* 12, 111-116

[19] Habtamu K, Alemayehu C, Bekele K, Tiwar K. **2012**. *International Journal of Life Sciences* 1, 8-15