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Research Article

Participatory Technology Evaluation for the Management of Late Blight of Potato in North Gondar, Ethiopia

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ABSTRACT

Ethiopia is known for potato production, but the productivity of the crop is low due to disease and insect pests. Late blight caused by Phytophthora infestans is one of the most significant constraints to potato production in the highlands of Ethiopia. A study was conducted to assess the integrated effects of a fungicide (Ridomil) and tow improved and local varieties (gudene, jalene and local) on late blight of potato. The experiment was laid out in randomized complete block design in a factorial arrangement with three replications at tow locations at chiliga districts for tow years (2018 and 2019).

Both variety, fungicide showed highly significant (P<0.01) differences for all the characters except variety by fungicide interaction. The highest total tuber yield (29.580 t ha-1) and the lowest disease severity (80.2%) were recorded from improved varieties, Jalene. The highest disease severity and consequent lowest total tuber yield were recorded on local cultivar and un sprayed.

Application of Ridomil at weekly interval was found to be effective for control of the disease on Improved varieties. However, for Jalene and Gudene, application of Ridomil at one's a week interval was effective for management of late blight in the highlands of Western Amhara region.

Keywords: Late blight, Fungicide, IDM, Potato

INTRODUCTION

Potato (Solanum tuberosum L.) is one of the most important food and cash crop belonging to the family solanaceae. Potato is a staple food crop for rural people in the cool highland parts of Ethiopia where the environment precludes the production of common cereals but does support hardy crops such as barley and cool season food legumes (Tesfaye et al., 2013). Potato is among the major crops produced in the highlands of Amhara Region. The region contributes 29.67% out of the total potato production in the country with average productivity of 154.36 Qt/ha (CSA, 2014/15).

A number of plant pathogens cause foliar diseases of potato (Solanum tuberosum). Late blight, caused by Phytophthora infestans (Mont.) de Bary, is a persistent threat to potato crop production worldwide. P. infestans is the type species of the genus Phytophthora and may be the most important disease of potato (Fry and Goodwin, 1997; Taylor et al., 2008; Touseef et al., 2013)

The Oomycete, Phytophthora infestans, which causes the disease of late blight or necrotic tissue, appears especially at high relative humidity and in low-temperature areas, causing the death of leaves, stem and tubers of the plant. It can also completely destroy the cultivation in a short period of time; therefore it is

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considered the most serious problem for production of Solanaceae crops worldwide (Agrios, 2004). The asexual cycle enables dramatically rapid population growth in susceptible host tissue. Sporangia are produced on sporangiophores that grow from infected tissue. The sporangia are readily dehiscent, particularly in response to changes in relative humidity, and can be aerially dispersed to other plant tissues (Aylor et al., 2001). Sporangia in free water germinate either via a germ tube at higher temperatures (optimum around 20–25 °C), or by releasing wall-less zoospores at lower temperatures (optimum between 10 and 15 °C) (Melhus, 1915).

Objectives

- To evaluate the effectiveness of integrated management of late blight of potato in the study area
- To assess farmers perception towards the integrated management of late blight of potato in the study area

MATERIALS AND METHODS

Field experiment was conducted at Chilga on farmer's field in randomly complete block design with three replications.

A plot size of 3m*3m with a spacing of 0.75m, 0.3m, 1m and 1.5m between rows, plants, plots and replications, respectively were used.

Improved varieties (Gudene and Jalene) including local were used in combination of one time and two times spray of Ridomil fungicide. While unsprayed Gudene, Jalene and local were serve as a control. First application of fungicide was done immediately when the disease symptom is observed on control plots Secondary spray was done ten days after the first application. Assessment for late blight severity were conducted using Muzeeb-Kaazi, A.etal.,1996a disease assessment scale.

TREATMENTS

Ridomil gold with Jalene/single spray/

Ridomil gold with Gudene /single spray/

Ridomil gold with local/single spray/

Ridomil gold with Jalene /double spray/

Ridomil gold with Gudene /double spray/

Ridomil gold with local /double spray/

Untreated Jalene variety

Untreated Gudene variety

Untreated Local

Disease Severity Assessment

Diseases severity was recorded using double digit method (Muzeeb-Kaazi, A. et al., 1996). Disease severity (%) = (D1/9) × (D2/9) ×100

Where, D1= First digit (height of infection) and D2= Second digit (severity of infection)

The area under disease progress curve (AUDPC) was calculated for severity using the formula: Xi+1

$$AUDPC=\sum_{i=1}^{n-1}\left[(0.5(X_i+X_{(i+1)}))\right](t_{(i+1)}-t_i)$$

Scale for height of infection	Height	Scale for severity	Leaf area coverage (%)
1	lowest leaf	1	10
2	second leaf from base	2	20
3-4	second leaf up to below middle plant	3	30
5	up to middle of plant	4	40
6-8	from center of plant to below the flag leaf	5	50
9	up to flag leaf	6	60
		7	70
		8	80
		9	90

RESULTS

The frequency of Chemical Application and Variety Selections Farmers Research and Extension Group (FREG) were Established

The members (11 male and 4 female) were trained about potato production, diseases identification, chemical application and FREG concepts..

The selection criteria's were disease occurrence and severity, number of branch per plant and plant height.

The members were weight each selection criteria and gave score from 1 which is very poor up to 4 score which is very good scores.

Table 1: Weighted selection criteria

Selection criteria	1	2	3	4	Total	Rank	Weight
Disease occurrence and severity		1	1	1	3	1	4
Plant heat			3	4	0	4	1
Branches				3	3	2	3
Shank thickens					1	3	2

Table 2: Frequency of chemical application with variety selection by FREG members

Selection criteria	Jalene 2	Jalene 0	Gudene 1	Local 2	Local 0	Gudene 2	Gudene 0	Local 1	Jalene 1
Disease occurrence	4*4=16	2*4==8	5*4=20	2*4=8	1*4=4	5*4=20	4*4=16	2*4=8	4*4=16
Plant height	4*1=4	2*1=2	3*1=3	2*1=2	1*1=1	4*1=4	3*1=3	2*1=2	3*1=3
Number of branch	3*3=9	2*3=6	3*3=9	2*3=6	1*3=3	3*3=9	2*3=6	3*3=9	4*3=12
Stalk thickness	3*2=6	3*2=6	3*2=6	2*2=4	1*2=2	3*2=6	3*2=6	2*2=4	3*2=6
Total	35	22	38	20	10	39	39	23	37
Rank	4	7	2	8	9	1	5	6	3

Table 3: Yield and severity response of varieties to late blight at Chilga in 2018

Treatments	Severity and Yield			
Variety	MY/tha	UN/tha	TY/tha	AUDPC
Jallene	27.994a	1.5864a	29.580a	80.2a
Gudene	25.250a	1.2624a	26.512a	333.3b
Local	7.664b	1.2747a	8.938b	1483.5c
Mean	203025	1.3745	2.1677	632.4
CV	18.2	31	17.3	17.6
LSD (5%)	3.6972	0.4258	3.749	111

Table 4: Yield and severity of potato on different spray frequency at Chilga in 2018

Treatments	Severity and Yield			
Spray frequency	MY/tha	UN/tha	TY/tha	AUDPC
Two times	20.522a	1.3457a	21.867a	603.9b
One times	21.503a	1.2901a	22.793a	572b
Unsprayed	18.883a	1.4877a	20.370a	721.2a
Mean	20.3025	1.3745	21.677	632.4
CV	18.2	31	17.3	17.6
LSD (5%)	3.6972	0.4258	3.749	111

Table 5: Yield and severity response of varieties to late blight at Chilga in 2019

Source of variation	MY/tha	UN/tha	TY/tha	AUDPC
Jalene	18.8346a	1.3580a	20.1926a	2.0 (186.0)a
Gudene	18.2607a	1.2356a	19.496a	2.2 (142.1)b
Local	11.504b	1.3963a	12.901b	2.8 (440.6)c
Mean	16.200	1.330.03	17.530	2.2
Cv	12.0	33.3	12.0	7.3
Lsd	1.9558	0.443	2.0134	0.16

Table 6: Combined Anova for 2018 and 2019

Source of variation	Df	MY	UN	TY	AUDPC
varieties	2	**	Ns	**	**
spray	2	*	Ns	*	**
V*s	4	ns	Ns	Ns	Ns

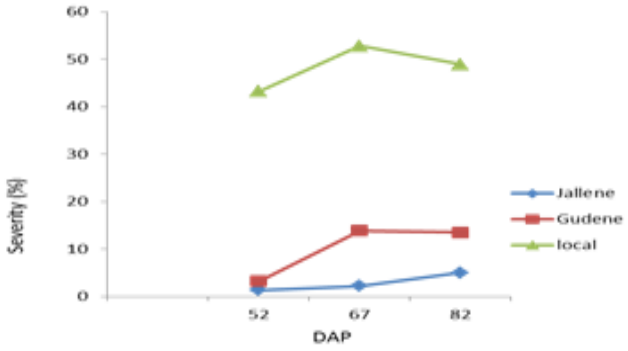
rep	2	*	Ns	*	Ns
cv		12.0	33.3	11.4	7.3

Table 7: Yield and severity response of varieties to late blight at Chilga in 2018/19

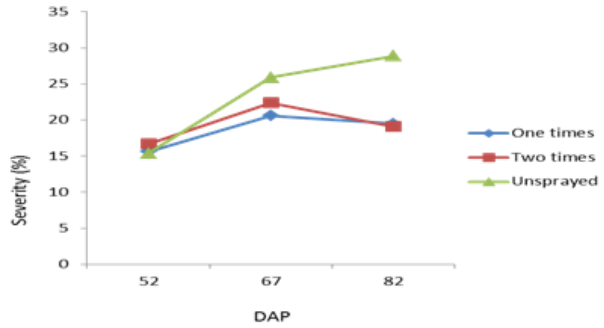
Source of variation	MY/tha	UN/tha	TY/tha	AUDPC
Jalene	23.4a	1.48a	24.9a	2.0(133.1)a
Gudene	21.7a	1.33a	23.0a	2.2(237.7)a
Local	9.5b	1.47a	10.9b	2.8(962.1)b
Mean	18.2	1.35	19.603	2.3
CV	26.9	30.3	25.4	12.7
Lsd	13.3	2.7	3.3	0.2

Table 8: Yield and severity of potato on different spray frequency at Chilga in 2018/19

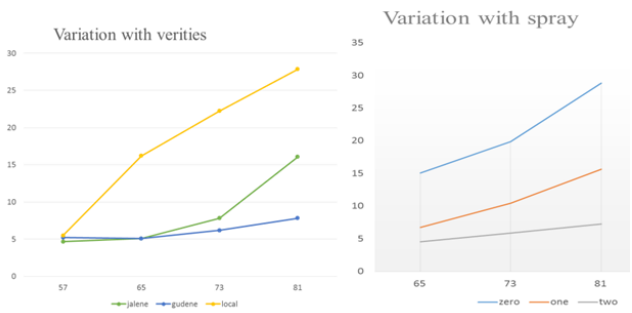
	MY/t/ha	UN/t/ha	TY/t/ha	AUDPC
One	19.487a	1.3531a	20.840a	2.3(394.9)a
Two	18.864a	1.3599a	20.224a	2.2(368.9)a
Zero	16.403b	1.3438a	17.747b	2.5(569.1)b
Mean	18.2513	1.3522	19.6036	2.3
Cv	12	33.3	12	12.7
Lsd	3.3019	0.443	3.357	0.2



Disease progres curve 2018



spray frequency



Disease progress Curve 2019

Partial budget analysis of fungicides sprays frequency versus unsprayed treatments

Treatment	AG Y	TR	TVC	MC	MR	MRR
Control	147.627	177152.4	0	0		
Single	169.776	203731.2	1300	1300	26578.8	2,044.52
Double	175.383	210459.6	2600	1300	6728.4	517.57

Spending one birr for spray will have 2044 birr return on single spray Where, AGY= Adjusted Grain Yield, TVC=Total Variable Cost, TR= Total Revenue, MC =Marginal cost, NP=Net

Profit ,MB= Benefit, MRR=Marginal Rate of Return, MY=marketable yield, UN= unmarketable yield TY=total yield 1 kg potato=12 birr 1kg Redomil= 1200 birr, daily labor = 100 Birr day -1 Marginal

CONCLUSION AND RECOMMENDATION

High disease was occurred on the local variety than the improved varieties. The improved varieties Jalene and Gudene were with low disease severity and gave the higher yield than the local varieties, One and two times sprayed were with low infestation of the disease and high yield. Unsprayed treatments were with high severity and low yield,

High marginal rate of return found on one time sprayed treatments, where as Farmers select Gudene and Jalene with one and two times sprayed, So improved verities Jalene and Gudene with one times spray used effectively to control late blight of potato disease and to increase potato product and productivities.

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