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Full Length Research Paper

Integrated Management of Potato Late Blight in the Bale Highlands, South Eastern Ethiopia, Using Varieties and Fungicide

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Bale Zone South Eastern 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 Bale highlands. A study was conducted to assess the integrated effects of a fungicide (Mancozeb 80 WP) and three varieties (Kellecho, Hunde and Ararsa) on late blight of potato. The experiment was laid out in randomized complete block design in a factorial arrangement with three replications at three locations (Sinana, Goba and Disho districts). All variety, fungicide and variety by fungicide interaction showed highly significant ($P \leq 0.01$) differences for all the characters, except for a number of tuber per hill. The highest total tuber yield (26.8 t ha^{-1}) and the lowest disease severity (48.8%) were recorded from one of the improved varieties, Ararsa, which was sprayed with the fungicide at weekly interval. The highest disease severity and consequent lowest total tuber yield were recorded on local cultivar kellecho and four times application of Mancozeb at weekly interval was found to be effective for control of the disease on local cultivar kellocho. However, for Ararsa and Hundie, application of Mancozeb at twice a week interval was effective for management of late blight in the highlands of Bale.

Keywords: Late blight, Fungicide, IDM, Potato.

INTRODUCTION

Late blight caused by *Phytophthora infestans (Mont.)* de Bary, is one of the most important diseases of potato worldwide. It is the main biotic production constraint of the crop in the highlands of Bale (Asefa *et al.*, 2016). Losses due to this disease were estimated to be 65-70% and complete crop failures are frequently reported (Bekele and Yaynu, 1996). To manage late blight, farmers have increasingly adopted fungicide application as the main control strategy. The combined uses of fungicide and resistant varieties have evolved as one of the most important options in the management of late blight of potato (Abreham *et al*., 2009). Integrating fungicide applications with varieties by choosing the best fungicide-cultivar combinations improves the durability/sustainability of the released potato varieties in the potato production system. This is particularly important in developing countries such as Ethiopia, where potato breeding programs depend entirely on (International Center of Potato) CIP materials. The variety development, which involves evaluation, selection, release and registration procedures pass through several stages. Hence, integration of fungicides with cultivars should be commonly practiced for sustaining the production of potatoes in the region. Accordingly, this study was conducted to determine the combined effects of varieties (*Hunde, Ararsa* and *Kellecho*) and fungicide (Mancozeb 80% WP) for the management of late blight of potato.

MATERIALS AND METHODS

A local potato variety, *Kellecho* and two improved varieties, *Hunde* and *Ararsa* were planted in plots with the size of 4.5m x 3m at Sinana on-station, Goba and

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Dinsho District during 'Gena' cropping seasons of 2013, 2014 and 2015. During the onset of late blight, chemical fungicide (Mancozeb 80% WP) was applied to each variety at recommended rate in three different spray schedules viz., every 7, 14 and 21-days. The spray was continued at specified intervals until the crop attained its physiological maturity. The experimental design was randomized to complete the block design (RCBD) with a factorial arrangement with 3 replications. Unsprayed plots of each variety were included as a control. Recommended row and plant spacing were (0.75 and 0.3 m, respectively), fertilizer rate (195 kg/ha DAP and 75 kg/ha urea) and agronomic practices were used. Tuber yield was harvested from the middle four rows of each plot and converted to tone per hectare.Disease severity was assessed on weekly basis starting from the onset of the late blight until the crop attained its physiological maturity as a percentage of leaf area affected by late blight.

Data on tuber yield and disease severity were subjected to analysis of variance using GenStat 15th edition computer software. Means that are significantly different were compared using Duncan Multiple Range Test (DMRT) of probability at 5% probability of significance.

RESULTS

Analysis of variance indicated the presence of significant at ($P \leq 0.05$) and ($P \leq 0.001$) differences among varieties, chemical, and variety * chemical interactions for most of the studied traits except a number of tuber per hill (Table 1). This may allow us to select a combination of varieties with higher yield, late blight tolerant and less chemical application to produce potato effectively. This is in line with Habtamu *et al.* (2012) who indicated significance difference for a combination of different varieties for different chemical application frequency.

Mean Performances of varieties

Late blight was recorded in all locations, Sinana on station, Goba and Dinsho with different severity during the period this experiment was conducted. The highest late blight severity (97%) was recorded as the unsprayed plot of susceptible variety, *kellecho,* while the lowest (48.8%) was on weekly fungicide sprayed plots of one of the improved variety, Ararsa. On unsprayed plots of the released varieties, *Ararsa* and *Hunde*, disease severity was reached 75 and 77.7%, respectively. Among fungicide sprayed plots, the highest late blight severity (97%) was recorded on local variety, Kellecho, which was sprayed with the fungicide at 21-days interval (Table 2). Generally, application of mancozeb reduced the progress of the disease. This is in line with previous reports by Bekele and Hailu, (2003) who suggested that the application of fungicide play a vital role in the management of late blight. Similar results were reported by Shiferaw *et al*. (2009) that indicated moderately resistant cultivar, *Gudanie*, hada clear AUDPC response to additional fungicide sprays, although apparently for about three sprays.

The highest total tuber yield (26.8 t ha^{-1}) was harvested from the released variety, *Ararsa*, on which late blight was controlled by spraying Mancozeb 80% WP at 7-days interval where as the lowest (14.3 th^{-1}) was from unsprayed plots of the local variety, *Kelecho*. Among fungicide sprayed plots, the lowest total tuber yield (14.3 t ha^{-1}) was obtained from variety *Kelecho*, which was sprayed with the fungicide every 21days.

More over marketable and unmarketable tuber yield were also varied between the interaction of variety and chemical application frequencies. The height unmarketable tuber yield (4.2 t ha^{-1}) was harvested from unsprayed plots of the local variety and the lowest (0.7t ha^{-1}) was from *Ararsa* which was sprayed with fungicide at weekly interval. This implies late blight can hinder the growth of crops which leads to unmarketable tuber yield. But in the present study a number of tuber per hill was recorded statistically the same for varieties as well as chemical application schedule. Unlike unmarketable yield, the highest marketable tuber yield was recorded from the released variety, *Ararsa,* which was sprayed with the fungicide every 7 days, while the lowest was recorded from unsprayed plots of the local cultivar, *Kellecho* (14.3 t ha^{-1}).

Both released varieties with different chemical application frequency recorded statistically the same total tuber yield across the location and year. However, released varieties namely *Ararsa* and *Hunde*, and local cultivar *Kellecho* with different chemical application recorded significantly different total tube yield. This may be due to the ability of variety viz. *Ararsa* and *Hunde* to resist or tolerate late blight of potato. This is in agreement with Shiferaw *et al*., (2011) and Abreham, (2009) who indicated varieties are differing in their reaction to late blight infection. Moreover local cultivar kellecho with chemical application frequency viz. weekly, 14 and 21 days recorded the highest unmarketable tuber yield (4.2 t ha^{-1}).

CONCLUSION

The highest total tuber yield (26.8t ha^{-1}) and the lowest disease severity (48.8%) was recorded from the released variety on which late blight was controlled by spraying Mancozeb every 7-days. The lowest total tuber yield (14.3t ha^{-1}) and the highest disease severity was recorded from the local cultivar, *Kellecho*. The released varieties Ararsa and Hunde, was recorded statistically as the same total tuber from 7, 14 and 21 days of chemical application. However, in the case of local cultivar *Kellecho*, total tuber yield is different from weekly, 14

Table 1. Analysis of variance on the effects of variety and fungicide combinations on late blight management and yield on three potato varieties

Source	DF	DS	NTPH	MTY	TTY
replication	2	482.6*	2.5ns	4.18	47.7*
variety	2	2770.6**	409.71ns	96.4**	237.4**
Chemical	3	93.0**	8.65ns	96.4**	7.5*
Variety * Chemical	6	88.2**	41.64ns	5.3*	23.8*
Error	94	405	15.6	3.1	108.1

ns - Statistically not significant *Significant at P< 0.05 and **significant at P<0.01.DF= degree of freedom, DS= disease severity NTPH= number of tuber per hill, MTY=marketable tuber yield, TTY= total tuber yield

Table 2. Varieties and fungicide combinations for late blight management on number of tuber per hill, unmarketable tuber yield, marketable tuber yield and total tuber yield.

TRT	NTPH	unMTY(t/ha)	MTY(t/ha)	TTY(t/ha)	DS(%)
Ararsa-control	16.36 ^{a}	1.3^{de}	17.8a-c	19.1^{b}	75 ^{cd}
Kelecho x 21	14.37^{a}	3.2^{ab}	15.3de	18.5 ^{c}	85^{bc}
Hunde x 7	16.14^{a}	2.0 ^{cd}	24.4ab	26.43^{a}	50 ^{f}
Kelecho - control	14.90^{a}	4.2 ^{a}	11.1e	14.3 ^{c}	97 ^{a}
Ararsa x 21	14.55^{a}	0.8 ^{e}	25.3a	25.1^{a}	80.5^{bc}
Ararsa x 7	14.59 ^{a}	0.7 ^{e}	26.1a	26.8^{a}	48.8^{f}
Kelecho x 14	16.52 ^{a}	3.9 ^{a}	15.6de	19.5 ^{b}	82.7 ^{bc}
Ararsa x 14	15.46^{a}	0.8 ^{e}	25.7a	26.5 ^{a}	70 ^{e}
Kelecho x 7	14.34 ^{a}	3.1 ^{ab}	17.6c-e	20.6 ^{ab}	49 ^{f}
Hunde x 14	17.57 ^{a}	2.5 ^{bc}	22.5a-d	25.1 ^{a}	75^{cd}
Hunde – control	18.99^{a}	2.6^{bc}	20.4b-d	23.4^{ab}	77.7 ^{e}
Hunde – 21	16.35^{a}	1.7 $^{c-e}$	24.2ab	25.9 ^{a}	75^{cd}
Range	14.37-18.9	0.7-3.9	11.1-26.1	14.3-26.8	48.8-97
mean	15.8	2.19	20.6	22.6	71.1
CV%	34.5	24.7	26	13.0	5.1
Level of significance	ns	**	**	*	**

ns=Statistically not significant, *=Significant at P< 0.05 and **=significant at P<0.001.df= degree of freedom, NTPH= number of tuber per hill, MTY=marketable tuber yield, TTY= total tuber yield, DS=disease severity

and 21 days fungicide application. In this cultivar, four times weekly chemical application is 41% yield advantages than unsprayed and 11% than 14 and 21 days of chemical application. This indicated that on local cultivar kellecho weekly application of mancozeb 80% WP save 41% of total tuber yield in the highland of Bale, while on *Ararsa* and *Hundie* weekly chemical application advanced total tuber yield by 13% than unsprayed. But weekly, 14 and 21 days of the chemical application was recorded statistically the same total tuber yield in both released varieties. This may be due to resistance/tolerance of both varieties to late blight infection. Similar results were reported by Bekele and Hailu,(2003) who indicated different varieties with different chemical application have different reactions toward chemical application frequency.

In conclusion, the present studies revealed a combination of resistant varieties with the different chemical application, schedules will be commonly practiced for sustainable production of potato in Bale highlands. Selection of tolerant varieties also reduced the frequency of chemical application. Hence, weekly four times mancozeb 80% WP application on local cultivar "*kellecho*" and two times on *Ararsa* and *Hunde* was recommended in the highland of Bale. In addition, the future potato improvement program in the study area should have to develop high resistant varieties to late blight other than these because this variety can be overpass by the disease very soon. Because the pathogen is known with high mutable characteristics that make resistant varieties susceptible soon after they deployed.

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REFERENCES

Abreham T (ed.) (2009). *Proceeding of the 14th Annual Conference of the plant protection Society of Ethiopia*, 19-22 December 2006, Addis Abeba, Ethiopia.

André D, Peter K, Oscar O (2014). Potatoes for Sustainable Global Food Security*European Association for Potato Research* 2014.

Bekele K, Hailu B (2003). Efficacy and economics of fungicide spray in the control of late blight of potato in Ethiopia. *African Crop Science Journal,* Vol. 9, No. 1, pp. 245-250.

Bekele K, Yaynu H (1996). Tuber yield loss assessment of potato cultivars with different level of resistance to late blight.pp. 149-152.

Berga L, Gebremedhin WG, Terrissa J, Bereke-Tsehai T (1994). Potato Agronomy Research. In: Edward Herath and Lemma Dessalegn (eds.). *Proceedings of the Second. National Horticultural Workshop of Ethiopia*. Addis Ababa, 1-3 December 1992.Institute of Agricultural Research and Food and Agriculture Organization, Addis Abeba Ethiopia.

Gebremedhin W, Endale G, Lemaga B (2008). Potato variety development. In Root and tuber crops: The untapped resources, ed. W. Gebremedhin, G. Endale, and B. Lemaga, 15-32. Addis Abeba: Ethiopian Institute of Agricultural Research.

Gildemacher P, Kaguongo W, Ortiz O, Tesfaye A, Gebremedhin W, Kakuhenzire R, Kinyae P, Nyongesa M, Struik PC, Leeuwis C (2009). Improving potato production in Kenya, Uganda and Ethiopia: a system diagnostics. *Potato Res* 52:173–205.

Habtamu K, Alemayehu C, Bekele K, Pananjay GBG ,Tiwari K (2012). Evaluation of different potato variety and fungicide combinations for the management of potato late blight in Southern Ethiopia. Int J Life Sci., Vol.1 No.1. 2012. 8-15.

Shiferaw M, Tameru A, Bekele K, Forbes G (2009). Evaluation of contact fungicide spray regimes for control of late blight (*Phytophthora infestans*) in southern Ethiopia using potato cultivars with different levels of host resistance. *Trop Plant Pathol*, vol. 36, 1, 021-027.

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