

PEST RISK ANALYSIS: ENVISAGED ECONOMIC IMPACT OF POWDERY SCAB OF POTATO IN SRI LANKA

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ABSTRACT

During pest risk analysis, perceived economic impact of the pest must be considered for evaluation of the target. If powdery scab of potato caused by *Spongospora subterranea* f.sp. *subterranea* is wide spread in the country losing its status as a quarantine pest, it could cause both direct and indirect economic consequences. Growth of potato plants will be significantly reduced due to the infestation by the pathogen. The disease causes severe blemishes on the surface of potato tubers thus affecting their market value. Annually, the country may lose more than Rs. 122 million. Difficulty in controlling the disease may prompt farmers to use more agrochemicals causing environmental and health problems. Import of potatoes for consumption will be increased to alleviate shortages due to crop failures and discard of harvest thus spending a significant amount of foreign exchange. The disease can affect the standard and cost of living of farmers dependent on potato cultivation unless they switched to other profitable crops. Thus, presence of powdery scab of potato in Nuwara Eliya and Welimada areas will invariably cause unacceptable economic consequences. As such, the pest should be considered as a quarantine pest that needs adoption of safeguards.

KEYWORDS: Economic impact, pest risk analysis, potato, powdery scab,
Spongospora subterranea f.sp. *subterranea*

INTRODUCTION

Harrison *et al.* (1997) and de Nazareno and Boschetto (2002) reported that powdery scab of potato (PSP) caused by *Spongospora subterranea* f.sp. *subterranea* J.A. Toml. is becoming a major pest of potato in several countries. Almost all potato varieties including those popularly grown in Sri Lanka are reported to be susceptible to this disease (Harrison *et al.*, 1997) and hence could become a threat to our country. Non-availability of effective control measures (Harrison *et al.*, 1997 and Merz and Falloon, 2009) also increases its risk. Stakeholders of potato industry must be aware of the biology, epidemiology and potential economic impact of the pest for it to be properly managed. As a result of pest risk analysis (PRA), de Silva *et al.* (2006) propose certain safeguards against this pest. Nonetheless, that PRA does not include the assessment of possible economic impact of the pest and the authors expressed to do it separately. Envisaged analysis was partly done by Rajathewa *et al.* (2006) in their study on PSP in Sri Lanka. Effects of

several factors were not considered in their work because of their different objectives and this study was done to complete the assessment of the potential economic impact of PSP.

MATERIALS AND METHODS

This analysis also followed the procedures recommended by International Plant Protection Convention (Anonymous, 1998 and IPPC, 1996 and 2003). Envisaged economic consequence was calculated referring to the agriculture statistics published by the Department of Agriculture (DOASL) and the Department of Census and Statistics of Sri Lanka (Anonymous, 2009a and Department of Census and Statistics, 2010). The effects were extrapolated to a hypothetical situation where the disease was thought wide spread in the country, thus losing its status as a quarantine pest. As indicated in de Silva *et al.* (2006), PRA area encompassed Nuwara Eliya and Welimada areas where potato is extensively grown. Area under potato cultivation changes every year and during 2001-2008, it varied between 4246 ha to 6605 ha (Department of Census and Statistics, 2010). If the pathogen establishes and spread in the PRA area, which according to de Silva *et al.* (2006) has a high potential, it was assumed that 10% of potato fields could be affected within 10 years and the consequences in terms of yield loss and other impacts could be similar to what happened in PSP endemic areas.

Under such circumstances, average monetary loss (M_{ia}) due to loss of area was calculated as

$$M_{ia} = A \cdot a\% \cdot Y_a \cdot F \dots\dots\dots (1)$$

where A = extent of cultivation (ha) of potato, which in 2002 was 6605 ha and in 2008 was 4832 ha (Department of Census and Statistics, 2010);

$a\%$ = percentage loss of cultivatable area due to PSP;

Y_a = Average yield of potato in 2008, which was 15370 kg ha⁻¹ (Anonymous, 2009); and

F = Farmgate price of potato in 2008, which was Rs. 55.02 per kg (Anonymous, 2009).

$$M_{iy} = Y_a \cdot y\% \cdot F \dots\dots\dots (2)$$

where $y\%$ = yield loss reported from areas where PSP is endemic.

In 2007, total volume of mancozeb imported was 342,930 kg and its CIF value was US\$ 592,010 (Anonymous, 2009a) and, considering one US\$

as equivalent to Rs. 100.00, it comes to Rs. 59 200 000.00. Thus, CIF value of one kg of mancozeb was Rs. 172.63.

For the presentation of the consequences, envisaged impacts were categorized as,-

- If <5%, unlikely to be discernible or not significant.
- If between 5-10%, minor significance,
- If between 10-30%, significant, and
- If >30%, highly significant.

RESULTS AND DISCUSSION

Direct pest effects

Table 1 gives the envisaged effect due to the perceived incidence of PSP. The land infected with PSP is considered not suitable for repeated potato cultivation and, for the reduction of the inoculum potential, no solanaceous crops should be grown there for several years (Melhus *et al.*, 1916, Harrison *et al.*, 1997, Merz and Falloon, 2009). Under such circumstances, the loss to the farmers over the years by not growing potato would be considerable (Table 1).

Table 1. Direct effect of PSP

<i>Envisaged Effect</i>	<i>Damage/Loss per year</i>	<i>Monetary value per year (Rs.)</i>	<i>Impact</i>
Loss of potato cultivation	10% of area (our assumption)		
	cf. year 2002*	558 556 712.70	Significant
	cf. year 2008*	409 958 476.00	Significant
<i>Yield loss (per ha) due to</i>			
Reduction of plant growth	19% (Falloon <i>et al.</i> , 1995)	160 674.91	Significant
Reduction of marketability	50% (Harrison <i>et al.</i> , 1997)	422 828.70	Highly Significant
Loss during storage	30-70% (CABI, 2007)	253 697.22- 591 960.18	Highly Significant

* Department of Census and Statistics (2010)

The disease usually has a cosmetic effect on potato tubers due to surface damage making them appear unsightly so that marketing can be difficult. Sorting the tubers is labour intensive and further reduces the financial returns from the crop, a factor not considered in this study. Severely blemished tubers could sometimes be more than 50%, and thus a considerable portion of the harvest should be discarded (Harrison *et al.*, 1997) resulting a highly significant loss to farmers (Table 1). During storage of tubers, PSP may enhance incidence of dry rot, pink rot and canker leading to a 30-70% loss (CABI, 2007). Falloon *et al.* (1995) reported that PSP could reduce plant

growth resulting 19% yield loss (Table 1). Severe infections may cause the plants to wilt and die thus destroying a considerable portion of the crop. Thus every year more than 8000 t of potato harvest would be lost.

Indirect pest effects

The fungus, *S. subterranea* can serve as a vector of potato mop-top virus (Brunt *et al.*, 1996, Miller, 2001), a disease absent in Sri Lanka. The potato mop-top virus (PMTV) could cause poor growth and unsightly symptoms on potato tubers. Being both a carrier and a vector of the PMTV, *S. subterranea* could introduce the virus into new locations (Harrison *et al.*, 1997, Miller, 2001) such as Sri Lanka. Harrison *et al.* (1997) report that with PSP, incidence of other diseases such as late blight (*Phytophthora infestans*), pink rot (*Phytophthora erythroseptica*), dry rot (*Fusarium* spp.) and rot caused by *Colletotrichum coccodes* could increase and nearly 20% of the yield would be lost (Table 2).

Table 2. Indirect effects of PSP

<i>Envisaged Effect</i>	<i>Result</i>	<i>Monetary Value per year (Rs.)</i>	<i>Impact</i>
Increase in incidence of other pests <i>Increase in production cost</i>	20% yield loss (Harrison <i>et al.</i> , 1997)	169 131.48 ha ⁻¹	Significant
Use of mancozeb	7.5 kg ha ⁻¹ (Faloon <i>et al.</i> , 1996) as against 1.2 kg ha ⁻¹ (Anonymous, 2009b)	1294.73 as against 207.16	Significant
Cost of research for PSP control	More funds	50 000.00*	Significant
Loss in foreign income due to problems for exports	No impact	—	Not Significant
Cost for import of consumption potato	More imports	1 021 486.70*	Uncertain

*Rough estimate

According to Merz *et al.* (2004), PSP once established in a field is difficult to control. Use of chemicals for disease management is not very promising (Melhus *et al.*, 1916, Braithwaite *et al.*, 1994, Falloon *et al.*, 1996, Secor and Rivera-Varas, 2004). During potato cultivation, the DOASL recommends use of 1.0-1.2 kg of Mancozeb per hectare for control of late blight (Anonymous, 2009b). However, according to Falloon *et al.*, (1996) this rate may enhance the PSP in the field and they recommend 7.5 kg of Mancozeb per hectare for its control. The five-fold increase in chemical application may result in more production cost (Table 2) and also environmental problems.

If cultivation of potato is not recommended in PSP infested fields, the farmers must grow other non-solanaceous crops. Perhaps the cost of planting of these crops would be less (Table 3) but the net return to farmers in certain seasons had shown more than what they got from potato while in some other seasons it was less than what they could have got by growing potato (Table 3). On the other hand, increase in land cultivated with crops like carrot and pole bean may lead to increase in their harvest, which may affect the farm gate price. However, analysis of such effects is beyond the scope of this analysis.

Table 3. Economy of planting alternate crops compared to potato

<i>Crop</i>	<i>Season</i>	<i>Cost of production (Rs. ha⁻¹) including imputed cost*</i>	<i>Net return (Rs/ ha)*</i>	<i>Profit/Loss compared to potato (Rs. ha⁻¹)</i>
Potato	2006/07 maha	534 652.00	293 197.00	-
	2007 yala	634 642.00	198 394.00	-
	2007/08 maha	638 421.00	163 258.00	-
	2008 yala	821 833.00	76 283.00	-
Cabbage	2006/07 maha	264 081.00	191 184.00	-102 013.00
	2007 yala	254 926.00	130 128.00	-68 266.00
	2007/08 maha	266 824.00	155 761.00	-7 497.00
	2008 yala	301 375.00	64 108.00	-12 175.00
Carrot	2006/07 maha	-	-	-
	2007 yala	273 960.00	302 058.00	+103 664.00
	2007/08 maha	313 174.00	260 199.00	+96 941.00
	2008 yala	358 913.00	41 948.00	-34 335.00
Pole bean	2006/07 maha	209 496.00	82 481.00	-210 716.00
	2007 yala	226 633.00	148 117.00	-50 277.00
	2007/08 maha	241 850.00	200 795.00	+ 37 537.00
	2008 yala	274 540.00	157 188.00	+80 905.00

*Data from Anonymous (2008 and 2009a)

Time and place factor

Initial effect of PSP will be seen at the site of original introduction (Melhus *et al.*, 1916). The build up of its population and migration will occur taking a considerable time though detailed information on this aspect is missing. Any attempts to arrest the spread using agrochemicals may not be successful (Melhus *et al.*, 1916, Braithwaite *et al.*, 1994, Falloon *et al.*, 1996, Merz *et al.*, 2004, Secor and Rivera-Varas, 2004). Many factors considered in pest risk assessment (de Silva *et al.*, 2006) may not change within the near future, esp. for Sri Lanka. Thus, there is hardly any reason to believe that envisaged economic losses due to PSP may be reduced within a short time.

Analysis of commercial consequences

Crop failures and discarding of a portion of the harvest (Table 1) may result in shortages and hence import of consumption potato will be increased

spending a large amount of foreign exchange (Table 2). Its effect on the economy cannot be predicted at this stage without data. The presence of PSP will not restrict export of other crops grown in the PRA area, except rooted plants contaminated with soil.

Non-commercial and environmental consequences

PSP may not adversely change bio-diversity, ecological stability *etc.* of the PRA area. Also, it may not affect employment or tourism. It is difficult to quantify such effects, and hence only qualitative indications are given (Table 4). Excessive use of agrochemicals for control of PSP may lead to pollution of the environment.

Table 4. Non-commercial impact of PSP

<i>Envisaged effect</i>	<i>Impact</i>
Meeting new phytosanitary measures during export of other crops	Not Significant
Social dislocation due to crop failure	Not significant
Inability to get credit for cultivation	Significant
Increased cost of living	Minor significance
Reduction in standard of living	Not significant
Environmental impact due to excessive use of pesticides	Significant
Environmental impact due to fallowing	Positive impact
Effect on biodiversity	Not significant
Effect on tourism	Not significant

Two decades ago, when the potato cyst nematode *Globodera rostochiensis* developed to epidemic proportions in the upcountry of Sri Lanka, the banks refused to give credit to farmers who cultivate potato in infested fields. The farmers, when applied for bank loans, which ranges from Rs. 50 000.00- 200 000.00 per hectare of potato fields, were asked to get the soils analyzed by the officials of the Department of Agriculture and get certification to the effect that the field is free of cyst nematodes. This attitude led to some socio-economic problems in the PRA area since farmers could not find money for cultivation of their land. One cannot rule out similar consequences with PSP too.

Since PSP could cause a high economic impact for potato cultivation in Sri Lanka, safeguards proposed by de Silva *et al.* (2006) could be adopted to mitigate its risk.

CONCLUSION

The perceived or extrapolated occurrence of PSP in the PRA area will significantly affect potato cultivation in Sri Lanka, by means of increasing the cost of production. Crop failures will also lead to import of consumption potato. The government has to allocate more money for research and management of PSP. The extrapolated occurrence of PSP in Nuwara Eliya and Welimada areas will invariably cause unacceptable economic problems.

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