

Management of Common Scab (*Streptomyces scabies*) of Potato

¹M.H. Hossain, ²S.K. Bhowal, ³A.K.M.S. Haque and ⁴A.S.M.M. R. Khan

¹Principal Scientific Officer, On- Farm Research Division,
Bangladesh Agricultural Research Institute, Comilla, Bangladesh

²Scientific Officer, On- Farm Research Division,
Bangladesh Agricultural Research Institute, Comilla, Bangladesh

³Principal Scientific Officer, ARS, Bangladesh Agricultural Research Institute, Comilla, Bangladesh

⁴Chief Scientific Officer, On- Farm Research Division,
Bangladesh Agricultural Research Institute, Gazipur, Bangladesh

Abstract: A field experiment was conducted at OFRD, BARI, Comilla and farmer's field of Matihara in Barura upazilla under Comilla district during the Rabi season of 2013-2014 and 2014-2015 to find out the effect of variety, boric acid, liming and poultry refuse for controlling common scab of potato. Three potato varieties viz., Diamant (BARI Alu-7), Cardinal (BARI Alu-8) and Asterix (BARI Alu-25) were used. Seven treatments i.e. T₁ = Tuber of cardinal (BARI Alu-8), T₂ = Tuber of asterix (BARI Alu-25), T₃ = Seed treatment with 3% boric acid before sporting, T₄ = 3% boric acid as spray at 50 days after planting, T₅ = Liming @ 150 kg ha⁻¹ were applied 7 days before planting, T₆ = Fresh poultry refuse @ 5 t ha⁻¹ were applied 21 days before planting and T₇ = Untreated control were used as check in this experiment. Out of seven treatments Diamant (BARI Alu-7) was used in five treatments (T₃-T₇). From the research findings it was revealed that in both on-station and on-farm situation, T₂ = Tuber of Asterix (BARI Alu-25) and T₃ = Seed treatment with 3% boric acid before sporting gave the best results among all the treatments to control percent common scab incidence with higher tuber yield followed by T₆ = Fresh poultry refuse @ 5.0 t ha⁻¹ were applied 21 days before planting in case of both the consecutive years. The untreated control treatment produced maximum disease incidence and minimum tuber yield in both the years. From cost and return analysis, it was observed that the highest gross return and gross margin were also recorded from the same treatment such as T₂ and T₃, respectively in case of on station and farmers field in both the years where the minimum gross return and gross margin was obtained from untreated control plots.

Key words: *Streptomyces scabies* • Incidence • Management approach • Potato common scab • Yield and yield loss

INTRODUCTION

Potato, the world's fourth most important food crop after wheat, maize and rice, provides balanced source of starch, vitamins and minerals to many communities in the global villages [1]. In Bangladesh, potato is the third largest crop after rice and wheat. It is used primarily as a vegetable and has potential as a staple food. Potato cultivation in the Bengal was promoted by a British Governor in 1770s and then it was a well established garden vegetable. Annual consumption of potato has

been growing rapidly, from around 7 kg per capita in 1990 to more than 25 kg in 2005 [2]. In Bangladesh, the potato has become a highly successful (October to March) winter crop with a production of 4.1 million MT in 2006. This placed the country fifth in Asia and fifteenth in the world in terms of the amount of potato produced [3]. In Bangladesh, so far as many as 57 diseases in potato have been recorded [4]. Among them late blight, stem rot /*Sclerotium* rot, wilt, common scab, potato leaf roll and mosaic are the most important diseases [5]. Common scab of potato is caused by a soil and seed borne bacterium [6].

Corresponding Author: S.K. Bhowal, Scientific Officer, On- Farm Research Division,
Bangladesh Agricultural Research Institute, Comilla, Bangladesh.

Streptomyces scabies is now known to occur in almost all potato growing areas of the world [7, 8]. In Bangladesh, this disease was initially a minor disease, but now becoming a major disease and incidence of the disease is increasing day by day. It changes tuber appearance and quality [9]. Infection causes tubers to have a scab like surface lesion which results in lower tuber quality [10]. It changes mature tuber appearance and quality. Lesions are dark pits that can be as deep as a quarter inch. Though the disease does not cause appreciable reduction in yield, it can cause great loss due to reduction of market value of tuber [11]. Moreover, infected seed tubers serve as the primary sources of inoculum for the next season [12]. It is not clear what factors directly determine the nature of the scab symptoms and different symptoms can be caused by strains of the same species [13]. The percentage of disease incidence at Barura upazilla in Comilla was 23.9% and in case of potato tubers, the highest scab incidence was observed in Cardinal (BARI Alu-8) (54.08%) followed by Binella (50.71%) and Diamant was medium susceptible potato variety where the incidence to common scab was 40.96% [14]. To control common scab, different cultural practices such as use of resistant variety, maintaining soil pH levels at 5.0-5.2, avoidance of heavy liming, crop rotation and reasonable soil moisture has some positive effects. But, it is not sustainable and not always consistent. Therefore, an effective disease control strategy before sowing is needed to control potato scab. In this view, the present investigation was undertaken to find out the effective control measure using different seed and soil amendment to control potato scab under field condition and to avoid deterioration of tuber quality and yield due to scab.

MATERIALS AND METHODS

The experiment was carried out by using Randomized Complete Block Design (RCBD) with three replications at on-station research field and farmer's field of Matihara in Barura upazilla under Comilla district during the Rabi season 2013-2014 and 2014-15 to find out the effect of variety, boric acid, liming and poultry refuse for controlling common scab of potato. The unit plot size was 3.5 m x 3.0 m. Tuber of Diamant (BARI Alu-7), Cardinal (BARI Alu-8) and Asterix (BARI Alu-25) were used in this experiment in both the years. During 2013-14, the tubers of potato were sown on 20 November, 2013 and 25 November, 2014 at on-station and 22 November, 2013 and 28 November, 2014 at farmer's field, respectively with a

spacing of 60 cm apart from rows and 20 cm from tuber to tuber in all treatments. Seven treatments were used in this study. Out of seven treatments, potato variety Diamant (BARI Alu-7) was used in five treatments *i.e* T₃-T₇. The treatments were, T₁ = Tuber of Cardinal (BARI Alu-8), T₂ = Tuber of Asterix (BARI Alu-25), T₃ = Seed treatment with 3% Boric acid before sporting, T₄ = 3% Boric acid as spray at 50 days after planting, T₅ = Liming @ 150 kg ha⁻¹ were applied 7 days before planting, T₆ = Fresh poultry refuse @ 5 t ha⁻¹ were applied 21 days before planting and T₇ = Untreated control. The fields were fertilized with 150-45-130-15 kg ha⁻¹ of N, P, K and S in the form of Urea, Triple Super Phosphate (TSP), Muriate of Potash (MOP) and Gypsum, respectively, along with cow dung @ 10 t ha⁻¹. The insecticides, Furadan (Carbandazim) and Stable Bleaching Powder were used 07 days before potato planting @ 30 and 33 kg ha⁻¹ for controlling cutworm and prevention from soil borne diseases, respectively. Manure was applied during final land preparation. Half amount of Urea and all other fertilizers were applied at the time of potato sowing beside the potato rows. Rest half amount of the Urea was top dressed at 35 days after planting (DAP). Rouging, irrigation and other intercultural operations such as weeding, earthing up were done as and when necessary for proper growth of the crop and maintaining hygienic conditions of the crop. Insecticide (Admire 200 SL) (Emidacloropid) was sprayed 2-3 times, starting from 25 DAP at every 10 days interval for controlling aphids and white fly. Fungicide, Dithane M-45 (Mancozeb) was sprayed @ 2.5 g per liter of water at 30 DAP and Secure 600 WG (Fenamidon + Mancozeb) @ 2.0 g per liter of water was sprayed at 40, 50 and 60 days after planting for the controlling of late blight disease. The hump pulling of potato was done 80 days after planting on 8th February, 2014 and 15th February, 2014 at on-station and 12th February, 2014 and 8th February, 2015 at farmer's field, respectively. The crop was harvested after 85-90 days after sowing on 19-23 February, 2014 and 18-25 February, 2015. All necessary data were noted at the period of harvesting. Data on germination, % scab infection, yield and yield contributing characters of potato were recorded. Disease incidence was calculated on the basis of number and weight of infected tubers and it was expressed in percentage. Disease severity was recorded based on the symptom as shown on the surface of the tuber. One hundred tubers were selected randomly, categorized into 0-5 scale [15] and finally percentage of disease incidence was calculated following the formula of [16]. Scab incidence was calculated as total number of

infected tubers divided by total number of harvested tuber and multiplied by 100. Tubers harvested from each plot were graded for determination of scab severity. Tubers were scored individually for scab severity according to the scale [17] such as: 0 = No symptom on potato tubers, 1 = 1% or less scabby area of tuber, 2 = 1-10% areas affected with sunken scabby lesions, 3 = 11-20% area affected with dip pitted lesions, 4 = 21-50% area affected with dip pitted corky lesions, 5 = 51% or more area affected with severe corky lesions. Collected data were analyzed using MSTATC software. All percentage data were transformed before subjecting to ANOVA. The mean separation among the treatments tested showing significant differences was done by LSD test [18].

RESULTS AND DISCUSSION

On-Station (OFRD Research Field): Data on scab infection (%), plant height, number of shoot plant⁻¹, number and weight of tuber plant⁻¹ and tuber yield t ha⁻¹ were determined and results are presented in Table 1. From the Table 1, it was observed that, the highest percent scab infection (18.07) was recorded from the treatment T₇ i.e. untreated control followed by T₁, T₅, T₆, T₄, T₃ and the lowest (6.18) from T₂ treatment i.e. tuber of Asterix (BARI Alu-25) in both the consecutive years. The finding of the result also supports the results of Anonymous [19], who mentioned that red skinned cultivars were least susceptible to common scab as compared to white skinned cultivars except old variety, Cardinal (BARI Alu-8) and quality of potato is a vital factor now a days and qualitative losses of potatoes due to scab disease may be minimized if the cultivars like Laura (BARI Alu-34), 4.26 R (BARI Alu-36), Sagitta (BARI Alu-31) and Asterix (BARI Alu-25) were cultivated against common scab disease. There was no significant difference among the treatments T₄, T₅ and T₆. In case of plant height and number of shoot plant⁻¹, the treatment T₂ gave the maximum plant height and number of shoot plant⁻¹ and the minimum from T₄ was recorded. Maximum number of tuber plant⁻¹ (10.07) was produced by the treatment T₁ i.e. the variety of Cardinal (BARI Alu-8) and minimum (6.37) in T₇. Other treatments such as T₂, T₄ and T₅ gave statistically similar results. Maximum weight of tuber plant⁻¹ (444.67 g) was recorded from the treatment T₂ that was followed by T₁, T₆, T₃, T₅ and minimum from T₇. There was no significant difference in the treatment T₁, T₃, T₄, T₅, T₆ and T₇ in case of weight of tuber plant⁻¹. The height tuber yield (34.53) ton per hectare were recorded from T₂

that was statistically similar with T₁, T₆ and T₅ and the lowest from T₇, which was statistically identical with T₄.

Farmer's Field (MLT site, Barura): Plant characters and yield attributes of potato along with % scab infection were presented in Table 2. From the research findings at farmers field level, it was observed that, the highest (16.91) percent scab infection was documented from the treatment untreated control (T₇) followed by T₁ (15.66) and the lowest (4.53) from T₂ treatment where the tuber of Asterix (BARI Alu-25) were used. Among the seven management approach against common scab of potato none of them are fully fitted to *Streptomyces scabies*, which also supports the research findings of [10] who documented that among the twenty cultivars none of the cultivars was resistant to common scab of potato. There was no statistically significant difference among the treatments T₄, T₅ and T₆ in the study. In case of plant height and number of shoot plant⁻¹, the treatment T₂ treatment i.e. tuber of Asterix (BARI Alu-25) gave the maximum plant height and number of shoot plant⁻¹ and the minimum from T₇. On the other hand, T₆ treatment i.e. fresh poultry refuse @ 5 t ha⁻¹ were applied 21 days before planting was produced maximum number of tuber plant⁻¹ (10.80) and minimum in T₇. The treatments T₁, T₂, T₃, T₄ and T₅ gave statistically similar results. Maximum weight of tuber plant⁻¹ (696.67g) was recorded from the treatment T₂ that was followed by T₅, T₆, T₃ and minimum from T₇. There was no significant difference in the treatment T₁, T₃, T₄, T₅, T₆ and T₇ in case of weight of tuber plant⁻¹. From different management practices against common scab of potato at farmer's field condition it was observed that the highest tuber yield were recorded from T₂ that was statistically similar with T₃ and T₆ and the lowest from T₇, which was statistically identical with T₄.

Cost and Return Analysis: Total variable cost (TVC), gross return and gross margin of different management approaches for controlling common scab of potato were shown in Table 3. Among the different management approach, the highest gross return (Tk. 267704 ha⁻¹ in on station and Tk. 310251 ha⁻¹ in on farm) and gross margin (Tk. 112342 ha⁻¹ in on station and Tk. 154889 ha⁻¹ in on farm) was recorded from T₂ treatment where the tuber of Asterix (BARI Alu-25) were used as planting material followed by T₃ and the lowest gross return (Tk. 241520 ha⁻¹ in on station and Tk. 224078 ha⁻¹ in on farm) and gross margin (Tk. 86158 ha⁻¹ in on station and Tk. 68716 ha⁻¹ in on farm) was found in control treatment (Table 3).

Table 1: Effect of different treatments on common scab, tuber yield and yield attributing characters of potato at OFRD, BARI, Comilla during the rabi season of 2013-14 and 2014-15 (Polled)

Treatments	% scab incidence	Plant height (cm)	No. of shoot plant ⁻¹	No. of tuber plant ⁻¹	Weight of tuber plant ⁻¹ (g)	Tuber yield (t ha ⁻¹)
T ₁	18.05	68.0	4.67	10.07	400.67	34.20
T ₂	6.18	73.47	7.0	8.50	444.67	34.53
T ₃	10.46	68.06	5.8	7.37	351.67	34.40
T ₄	17.39	62.27	3.9	8.13	324.33	30.73
T ₅	16.66	62.40	4.67	8.73	351.00	34.16
T ₆	15.11	64.07	4.20	7.70	386.33	34.47
T ₇	18.07	63.73	4.0	6.37	323.00	28.25
CV (%)	10.27	3.29	7.50	3.58	4.89	7.70
LSD (0.05)	1.25	1.22	0.58	1.02	25.20	2.10

Table 2: Effect of different treatments on common scab, tuber yield and yield attributing characters of potato at farmers' field of MLT site, Barura during the rabi season of 2013-14 and 2014-15 (Polled)

Treatments	% scab incidence	Plant height (cm)	No. of shoot plant ⁻¹	No. of tuber plant ⁻¹	Weight of tuber plant ⁻¹ (g)	Tuber yield (t ha ⁻¹)
T ₁	15.66	98.80	4.87	9.4	563.33	34.07
T ₂	4.53	102.0	6.27	8.47	696.67	39.22
T ₃	6.58	94.67	4.13	8.27	595.33	38.13
T ₄	11.20	86.80	5.03	7.73	563.33	31.09
T ₅	11.55	100.0	4.73	8.28	666.67	34.10
T ₆	10.72	92.27	4.50	10.80	650.00	38.59
T ₇	16.91	83.29	4.07	6.07	560.00	30.19
CV (%)	5.95	4.14	7.01	4.85	10.94	4.19
LSD (0.05)	1.20	6.98	0.60	1.17	119.50	2.65

Table 3: Cost and Return analysis of different management approaches against common scab of Potato

Treatment	Gross return (Tk. ha ⁻¹)		Total Variable Cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	
	On-station	Farmers field		On-station	Farmers field
T ₁	248976	261933	155362	93614	106571
T ₂	267704	310251	155362	112342	154889
T ₃	261440	300800	156620	104820	144180
T ₄	259180	234728	156622	102558	78106
T ₅	250515	256360	158362	92153	97998
T ₆	254926	288516	159360	95566	129156
T ₇	241520	224078	155362	86158	68716

Unit (Kg⁻¹) price of Potato (Fresh): Tk. 8.0, Potato (Scab infected): Tk. 4.0, Boric acid: Tk. 600, Dolochone: Tk. 10 and Poultry manure: Tk. 0.50

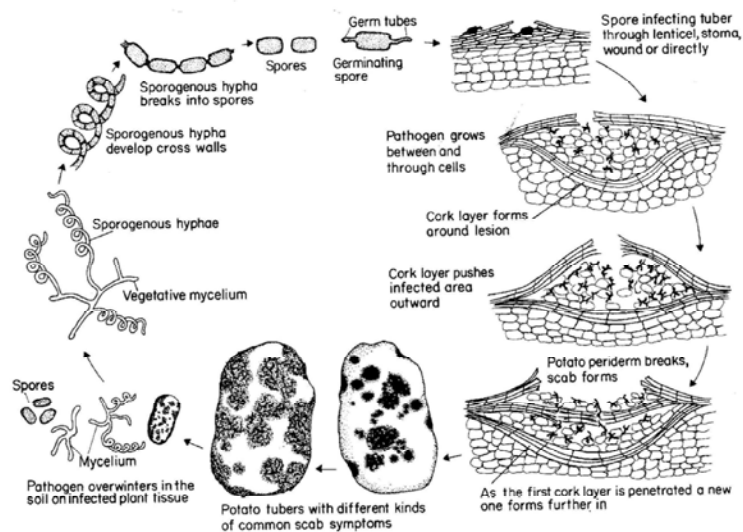


Fig. 1: Disease cycle of potato common scab (Agrios, 1997) [6].

CONCLUSIONS

Based on the research findings, it may be concluded that the tuber of Asterix (BARI Alu-25) and seed treatment with 3% boric acid before sporting are the best management approach among all the treatments to control per cent common scab incidence with higher tuber yield as well as highest gross return and gross margin followed by application of fresh poultry refuse @ 5 t ha⁻¹ at 21 days before planting and the minimum economic return was obtained from untreated control plots in case of both on-station and on-farm situation.

REFERENCES

1. Rowe, R.C., 1993. Potato health management: a holistic approach. Pages 154-156 In: R.C. Rowe (ed.). Potato health management. American Phytopathological Society, St. Paul, MN.
2. FAO., 2007. Food and Agricultural Organization of the United Nations. Rap. Pub., pp: 71.
3. Papademetriou, K. Minas, 2008. Workshop to Commemorate The International Year of The Potato. Food and Agriculture Organization of The United Nations Regional Office for Asia And The Pacific Bangkok, Thailand.
4. Hossain, M., T.K. Dey, S. Akhter, M.K.R. Bhuiyan, M.A. Hoque, B.C. Kundu, M.A. Hossain and S.N. Begum, 2008. Activities and achievements of Tuber Crops Research Centre at a glance. Tuber Crops Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur-1701, pp: 23.
5. Ahmed, H.U., M.S. Ali and T.K. Dey, 2000. Tuber crop disease management. Poster presented in the International Conference on Integrated Plant Disease Management for Sustainable Agriculture. Mitra DK (ed), Indian Phytopathological Society, New Delhi, India, 3: 1281.
6. Agrios, G.N., 1997. Plant pathology, 4th ed. Academic Press, San Diego.
7. Marais, L. and R. Vorster, 1988. Evaluation of pot and field trials for resistance of potato cultivars and breeding lines to common scab caused by *Streptomyces scabies*. Potato Res., 31: 401-404.
8. Sharma, K.D. and C. Sharma, 1989. Common scab of potato: Current status. In: Perspectives in Plant Pathology. Today and tomorrow's printers and publishers, New Delhi, pp: 315-331.
9. Ali, M.S. and T.K. Dey, 1995. Pathological research on tuber crops in Bangladesh. Workshop on transfer in technology under research-extension linkage program held at BARI, Gazipur, Oct. 22-27, 1997.
10. Mishra, K.K. and J.S. Srivastava, 2001. Screening of potato cultivars for common scab of potato in a naturally infested field. Potato Res., 44: 19-24.
11. Dutt, B.H., 1997. Bacterial and fungal diseases of potato. ICAR, New Delhi, pp: 196.
12. Anonymous, 2009. Annual report. Tuber Crops Research Centre, BARI, Gazipur, Bangladesh, pp: 204.
13. Loria, R., R.A. Bukhalid, B.A. Fry and R.R. King, 1997. Plant pathogenicity in the genus *Streptomyces*. Plant Disease, 81: 836-846.
14. Naher, N., M. Hossain and M.A. Bashar, 2013. Survey on the incidence and severity of common scab of potato in Bangladesh. J. Asiat. Soc. Bangladesh, Sci., 39(1): 35-41.
15. Liu, D., N.A. Anderson and L.L. Kinkel, 1995. Biological control of potato scab in the field with antagonistic *Streptomyces scabies*. Phytopathology, 85: 827-831.
16. Goswami, B.K., M.I. Zahid and M.Q. Haq, 2002. Screening of *Colocasia esculenta* germplasm to *Phytophthora* leaf blight. Bangladesh J. Plant Pathol., 9(1-2): 21-24.
17. Bakr, M.A., M. Sakhawat Hossain and H.U. Ahmed, (eds) 2010. A guide to Disease Identification, Data Recording, Rating Scale and Grading System of Major disease of Important Crops, pp: 74.
18. Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research. Intl. Rice Res. Inst. Philippines, pp: 187-233.
19. Anonymous, 2014. Annual report. On-Farm Research Division, BARI, Gazipur, Bangladesh, pp: 276.