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Impact of organic amendment on occurrence and management of major diseases of potato (*Solanum tuberosum* L.)

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Organic amendment in soil not only delays the establishment of early blight, late blight, leaf spots diseases but also reduced the disease severity. Maximum delayed appearance of early blight, late blight, leaf spots diseases was recorded on 07, 08 and 10, December, 2004 respectively in T4 treatment against 02, 02, 06 December, in control plant (T5), Similarly, minimum disease severity of early blight (20.12%), Phoma leaf spots (18.70%). Cercospora leaf spots (8.41%) and late blight (7.00%) was noted in T4 treatment whereas, maximum disease severity with 63.25%, 58.52% 17.08% and 15.47% was observed in T_5 treatment (control). Among the foliar diseases, late blight of potato gave the highest response to organic amendment which in turn delayed appearance and reduced disease severity.

Key words : Potato, organic amendments, Early blight, Late blight, Cercospora leaf spot, disease severity

INTRODUCTION

Organic amendment in organic farming is an agricultural system which aims at cultivation of the land in a way that the soil is kept dynamic with living activities and in good health, at the same time keeping the environment clean, maintaining the ecological balance and providing stability to the production level without polluting soil, water and air. This method is self-sufficient, self-dependent and self-reliant as compared to modern chemical farming. Organic amendment envisages a comprehensive management approach to improve the health and the underlying productivity of the soil. In a healthy soil, the biotic and abiotic components covering organic matter including soil life, mineral particles, soil air and soil moisture are in a state of dynamic equilibrium and regulate the ecosystem process in mutual harmony by complementing each other. If the soil is healthy and living, then the insect pest and disease problems are also controlled by nature. A number of fungal and bacterial species can also be used to suppress the population of plant pathogens (Menon, 2004). Presently, farmers are growing organic food using alternative sources of fertilizers and pesticides. Organic amendment increases the population of microflora in soil which has ability to suppress plant pathogenic fungi and insect pests and are potentially important alternatives to chemical pesticides (Rajik, 2007).

Organically grown crops produce better food quality than traditionally grown crops using chemical fertilizer and pesticides. But both quality and quantity are defoliated due to diseases caused by fungi, bacteria and viruses. Potato crop suffers from number of diseases namely; early blight, late blight, leaf spots, dry rot, charcol rot, black scurf, common scab, soft rot and many viral diseases. Indiscriminate use of chemical fertilizers and pesticides has resulted in various environmental and health hazards along with socio-economic problems. Though agriculture production has continued to increase but productivity rate per unit area has started to decline. Sustainable farming system, which is ecological, most sound, economical and

socially acceptable is need of the hour. Keeping the above points in view, the present investigation has been undertaken.

MATERIALS AND METHODS

The experiment was conducted during *Rabi* season 2004-05 at Main Experiment Station and Department of Plant Pathology, N. D. University of Agriculture & Technology Faizabad. All the laboratory experiments such as isolation, identification, maintenance of pure culture of fungus etc. were conducted in the Department of Plant Pathology.

Land preparation

Effect of organic farming on occurrence and management of important diseases of potato was determined through field experiment. The necessary irrigation was provided to the field before ploughing as to field come into the field capacity, facilities of soil tilth. The field was then ploughed with disc plough and twice with cultivator followed by planking in order to break the clods as well as to make soil pulverized. Besides, all the weeds were also removed manually. Then the soil was treated in various way as : T_1 = FYM @ 20 t ha^{-1} + biofertilizers (*Azotobacter*+Phosphobacteria 200 g each for 25 kg per ha), T_2 = FYM @ 10 t ha^{-1} + crop residues of preceding crop + biofertilizers (*Azotobacter* + Phosphobacteria). T_3 = FYM @ 20 t ha^{-1} foliar spray with Biodynamic (BD-500 @ 62.5 g/ ha) T_4 = Conventional cultivation (recommended package of practices for potato i.e. FYM @ 20 t ha^{-1} + 150:80:100 kg ha^{-1} NPK) and T_5 = Control (No organic manure and fertilizers).

The whole quantity of FYM @ 20 t ha^{-1} was incorporated in the soil at the time of last ploughing. In case of conventional method half quantity of nitrogen and full amount of phosphorus and potassium were applied in rows about 4-5 cm away from seed tubers and remaining quantity of nitrogen was top-dressed in furrows at the time of earthing up.

Tubers treatment with biofertilizers

The solution of jaggary was used for seed treatment with biofertilizers. It was prepared by dissolving 100 g of jaggary in one litre of water. 200 g each of *Azotobactor* and Phosphobacteria were added to this solution. Thus prepared solution was spread on the tubers and mixed thoroughly with the hands to obtain uniform coating. Treated tubers were kept in shade for drying. After drying the tubers were planted in experimental field immediately.

Bio-dynamics solution preparation

The solution was prepared by dissolving one gram of BD-501 in 13.5 litres of water and sprayed on the leaves in the form of 'mist' before sunrise at plant emergence stage (20 days after planting).

Measurement of disease severity

The crop was regularly observed for the first appearance of the individual diseases. Progress of the severity of individual diseases was also recorded at 15 days intervals except severity of late blight which was recorded at weekly intervals. The observations on date of first appearance and maximum severity per cent of each disease were recorded seperately. Disease severity was recorded using a score chart consisting of five (0, I, II, III, IV) for early and leaf spot disease. Fifty leaves were randomly selected from each treatment for measurement of disease severity. The leaves with no sign of infection received a score of zero while those with highest infection i.e. with the 76 or above leaf blighted received a score of I, II, III, respectively (Horsfall and Heuberger, 1942). For late blight of potato, disease severity was recorded by using 1 – 9 point scale where 1 – 9% infection received I, 10% infection received II, 11-25% infection received III, 26-40% infection received IV, 41-60% infection received V, 61-70% infection received VI, 71-80% infection received VII, 81-90% infection received VIII, 91-100% infection received IX (Malcolimson, 1976).

The disease severity of individual plants was calculated by following formula :

$$\text{Disease severity (PDI)} = \frac{\Sigma\text{Class rating} \times \text{class frequently}}{\text{Total no of leaves} \times \text{maximum class rating}} \times 100$$

RESULTS AND DISCUSSION

The results obtained from the field studies on effect of organic amendment on occurrence and severity of important diseases of potato are presented in Tables 1-3.

The data presented in the Table 1 showed that the early blight (*A. solam*) & leaf spot (*Phoma sorghina*) diseases appeared early than rest of others. The first appearance of early blight was at 2nd December, 2004 and maximum severity with 63.25 & 58.25 per cent was noted on 6th and 7th February, 2005 which was 65 and 67 days after first appearance of disease in T_5 (control plot). Whereas, in T_2 and T_1 treatments the first appearance of disease was observed on 4th December, 2004 and maximum severity with 50.50 and 43.87 per cent was recorded on 6th February, 2005 respectively in both the cases (64 days after first appearance). In T_3 treatment first appearance was noticed on 5th December, 2004 and highest severity of 41.02 per cent was found on 6th February, 2005 after 63 days after first appearance, However, in T_4 treatment first appearance of disease was on 7th December, 2004 and maximum severity of 20.12 per cent was recorded on 6th February, 2005 (62 days after first appearance). Similar trend was noticed in case of disease leaf spots caused by *Phoma sorghina* and *Cercospora* sp. The minimum disease severity (18.70 and 8.45 per cent) for both the diseases was recorded in T_4 followed by T_3 (41.12 & 11.33) while, maximum disease severity with 58.52 & 17.08% was recorded in T_5 (control) treatment. In case of late blight (*Phytophthora infestans*), first appearance of the disease was recorded on 20th December, 2004 and maximum

Table 1 : Effect of organic amendment on occurrence and severity of major diseases of potato cultivar Kufri Anand

Name of diseases	Treatment	Date of 1st appearance	Maximum severity (%)	Date of maximum severity	Maximum severity after 1st appearance (days)
Early blight	T_1	04.12.04	43.87		64
(*Alternaria*	T_2	04.12.04	50.50		64
solani)	T_3	05.12.04	41.02	06.02.05	63
	T_4	07.12.04	20.12		62
	T_5	02.12.04	63.25		65
Leaf spots	T_1	06.12.04	45.50		63
(*Phoma*	T_2	05.12.04	52.75		64
soghina)	T_3	08.12.04	41.12	07.02.05	61
	T_4	08.12.04	18.70		61
	T_5	02.12.04	58.52		67
Leaf spots	T_1	08.12.04	12.58		62
(*Cecospora*	T_2	08.12.04	14.08		62
sp.)	T_3	09.12.04	11.33	08.02.05	61
	T_4	10.12.04	8.45		60
	T_5	06.12.04	17.08		64
Late blight	T_1	22.12.04	15.47		30
(*Phytophthora.*	T_2	22.12.04	10.82		30
infestans)	T_3	23.12.04	14.45	21.01.05	31
	T_4	20.12.04	7.00		34
	T_5	22.12.04	15.02		32

Table 2 : Effect of organic amendment on disease severity of early and late blight of potato (cultivar Kufri Anand)

Treatment	Per cent disease intensity									
	Early blight (*Alternaria solani*)					Late blight (*Phytophthora infestans*)				
	At 27 DAS	At 42 DAS	At 57 DAS	At 72 DAS	At 87 DAS	At 44 DAS	At 51 DAS	At 58 DAS	At 65 DAS	At 72 DAS
T_1	5.37	10.50	29.65	36.75	43.87	1.72	4.47	11.00	15.00	15.47
	(13.52)	(18.89)	(32.99)	(37.31)	(41.48)	(7.49)	(12.11)	(19.37)	(22.79)	(23.11)
T_2	6.55	13.40	34.62	43.00	50.50	2.42	5.42	11.43	15.43	10.82
	(14.81)	(21.46)	(36.04)	(40.97)	(45.29)	(8.91)	(13.44)	(19.73)	(23.11)	(19.19)
T_3	4.37	9.00	26.90	32.62	41.02	1.05	4.05	10.05	14.05	14.45
	(12.06)	(17.42)	(31.24)	(34.83)	(39.82)	(5.74)	(11.54)	(18.44)	(21.97)	(22.38)
T_4	2.37	8.75	11.87	14.90	20.12	2.00	4.00	5.00	6.32	7.00
	(8.72)	(17.16)	(20.09)	(22.71)	(26.64)	(8.13)	(11.04)	(12.92)	(14.04)	(16.14)
T_5	8.25	18.17	46.87	55.37	63.25	1.50	4.15	7.50	9.00	15.92
	(16.68)	(25.23)	(43.20)	(48.10)	(52.68)	(7.04)	(11.08)	(16.89)	(17.40)	(23.50)
CD at 5%	1.12	1.57	2.95	2.08	2.56	0.49	1.20	1.34	1.69	1.68

Figures given in parentheses indicate transformed angular values; DAS-Days after sowing

Table 3 : Effect of organic amendment on disease severity of leaf spots caused by *Phoma sorghina* and *Cercospora* sp in potato (cultivar Kufri Anand)

Treatment	Per cent disease intensity									
	Leaf spots (*Phoma sorghina*)					Leaf spots (*Cercospora* sp.)				
	At 29 DAS	At 44 DAS	At 59 DAS	At 74 DAS	At 89 DAS	At 30 DAS	At 45 DAS	At 60 DAS	At 75 DAS	At 90 DAS
T_1	5.07	11.25	29.75	37.62	45.50	1.75	4.07	8.75	10.85	12.58
	(12.20)	(19.59)	(33.04)	(37.83)	(42.42)	(7.50)	(11.62)	(17.18)	(19.21)	(20.76)
T_2	6.55	14.37	32.87	42.25	52.75	2.07	4.60	9.37	11.60	14.08
	(14.78)	(22.25)	(34.97)	(40.54)	(46.58)	(8.28)	(12.37)	(17.82)	(19.90)	(22.03)
T_3	4.85	9.65	26.84	34.90	41.12	1.42	3.15	7.52	9.62	11.33
	(12.65)	(18.02)	(31.21)	(36.20)	(39.89)	(6.85)	(10.21)	(15.89)	(18.05)	(19.66)
T_4	3.25	6.62	8.42	11.00	18.70	1.05	2.35	3.25	5.37	8.45
	(10.31)	(14.87)	(16.85)	(19.37)	(25.62)	(5.88)	(8.81)	(14.20)	(16.29)	(16.85)
T_5	8.92	19.87	39.00	49.87	58.52	2.65	6.30	12.67	14.57	17.08
	(15.81)	(26.47)	(38.64)	(44.93)	(49.91)	(9.36)	(14.53)	(20.81)	(22.35)	(24.41)
CD at 5%	2.56	1.96	2.11	2.92	1.80	0.44	1.04	1.99	2.39	0.99

Figures given in parentheses indicate transformed angular values; DAS-Days after sowing

severity of 7.00 per cent was recorded on 21 January, 2005 (34 days after 1st sppearance) in T_4 treatment. In T_1 treatment, 1st appearance of disease was recorded on 22 December, 2004 and highest severity with 15.92 per cent was recorded on 21 january, 2005 (30 days after 1st appearance). The present findings agree with previous reports by several workers (Pathak, 1997; Basu *et al.,* 2003; Khurana 2000 and Singh *et al.,* 1993).

The data presented in the Table 2 showed that the disease severity per cent increased with increase in the age of the plant in all the treatments. The minimum disease severity of early blight with 2.37 per cent was recorded at 27 days of plant which gradually increased to 8.75, 11.87, 14.90 and 20.12 per cent at 42, 57, 76 and 87 days of plant respectively in T_4 treatment. Among the treatment, the lowest early blight intensity (20.12 per cent) was noted in T_4 treatment while, highest (63.22 per cent) in T_5 (control) at 87 days after sowing. Other treatments T_3 (41.02 per cent), T_1 (43.87 per cent) and T_2 (50.50 per cent) were significantly superior over control plot (63.25 per cent). Similarly, minimum late blight intensity (7.00 per cent) was recorded in T_4 treatment while, maximum (15.92 per cent) in T_5 treatment. T_4 treatment was significantly superior as compare to all the treatments. Koppel (2001) also reported that the first infection by late blight pathogen at 40 days after crop emergence and complete destruction of the haulm within the following 3 weeks. Similar findings had also been reported earlier by Hall *et al.* (1996).

Similar trend had also been recorded in case of leaf spots diseases, caused by *Phoma sorghina* and *Cercospora* sp. The disease severity caused by *Phoma sorghina* showed minimum 3.25, 6.62, 8.42, 11.00 and 18.70 per cent at 29, 44, 59 and 74 days, respectively in T_4 treatment. From the table it was also cleared that the disease severity caused by *Cercospora* sp. was comparatively lower than disease severity caused by *Phoma sorghina.*

The results exhibited that the organically treated plant gave highest response to organic amendment resulting in delayed appearance of major foliar diseases of potato and also protecting the plant against diseases.

REFERENCES

Basu A., Konar, A., Mukhopadhya, S. K. and Chettri, M. 2001. Biological management of late blight of potato using talc based formulations of antagonists. *J. Indian Potato Association,* **28**(1): 80-81.

Hall, C.E., White, E.M., Cooke, L. R., Little, G. and Saunders, A. R. 2004. Potato varieties for organic production in Northern Ireland. BGA/AAB/COR. Conference, Newport, Shropshire, UK, pp 236-239.

Horsfall, J. G. and Heuberger, J. W. 1942. Measuring magnitude of a defoliation disease of tomatoes. *Phytopath.* **32** (2): 226-232.

Khurana, S. M., Paul 2000. *Diseases and Pests of Potato.* CPRI Shimla, pp. 66.

Kopple, M. 2001. Suitability of potato varieties for organic growing. *Transactions Extonian* Agric. *Univ. Agron.,* **213**: 73-78.

Malcolimson, J. F. 1976. Assessment of field resistance to late blight (*Phytophthora infestans*) in potatoes. *Trans. Br. Mycol. Soc.* **67**: 321-325.

Menon, T.G.K. 2004. Organic farming for holistic living. *Prakarti Barti,* pp. 45-47.

Rajik, M. 2007. *Effect of organic amendments on soil micro flora and tuber borne diseases of potato (Solanum tuberosum,* L.) M.Sc. Thesis, N.D. Univ. of Agri. & Tech. Faizabad, India.

Pathak, S. P. 1997. Integrated disease mangement of late blight of potato. *International Conference on Integrated Plant Disease Management Sustainable Agriculture. IARI, New Delhi.* pp. 312.

Singh, B. P., Ray, S. and Bhattacharya, S. K. 1993. Late blight of potato. *International J. Tropical Plant Disease* **11**(1): 17-42.

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