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An Innovative Approach towards Organic Management of Late Blight in Potato under Inhana Rational Farming Technology

R. Bera[1], A. Seal[1]*, R. Roy Chowdhury[1], A. Datta[1], S. Saha[1], K. Sengupta[2]
[1]Inhana Organic Research Foundation, 168 Jodhpur Park, Kolkata, West Bengal, India
[2]Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal, India

Abstract
Successful disease combat of crop can ensure healthy return for the farmers. However, limitation in the conventional disease management approach, especially in case of late blight of potato was the background for the present study that aimed at bringing forth an alternative pathway for effective disease management. Integrated farming under Inhana rational farming technology (IRF) was adopted as an alternate protocol. The approach works on the philosophy of the Trophobiosis theory that advocates pest/disease management through plant physiology management. The study was done in two major potato growing zones of West Bengal taking two major potato varieties i.e., Kufri Jyoti and Kufri Chandramukhi. Late blight incidence varied from 2.82 to 7.91% in the IRF integrated farming plots whereas it was relatively higher varying between 49.44 and 66.67% in case of plots receiving conventional treatment. The finding remained consistent irrespective of the study area and potato variety. Ineffective disease management influenced the net loss of 2400 kg potato ha^{-1} under conventional farming. Percent disease index (PDI) was significantly high in case of conventional farmers' practice (11.37 to 32.81). However, lower values (PDI varies 1.45 to 2.59) under IRF integrated farming showed the effectiveness of its disease management schedule. Efficient disease management under IRF technology might have been brought about through a focused approach towards activation of plant physiology in order to re-instate plants' structural and biochemical defense mechanisms. The findings encourage the possibility of economically sustainable potato production under the changing climatic patterns.

Keywords: *Potato, late blight, organic disease management, IRF package of practice, plant defense system, Si uptake*

****Author for Correspondence*** E-mail: antaraseal77@gmail.com

INTRODUCTION

Late blight caused by *Phytophthora infestans* is the most devastating potato disease in the world [1]. It is a fungal disease that attacks the leaves, stems and tubers of potato plants. In recent years, highly aggressive strains of this disease, many insensitive to popular synthetic fungicides have surfaced and created new challenges for potato producers [2]. An increasing severity of late blight in many potato growing areas, a shift in pathogen population toward increased specific virulence and an increasing tolerance to the most effective late blight specific fungicides suggests a need to develop an appropriate disease management strategy [3]. Especially in case of organic agriculture, currently there is no effective control measure against late blight management apart from application of copper compounds but that also has limited effectiveness and restriction in use under organic certification.

So, in order to develop strategies towards organic management of potato late blight, a comprehensive management practice is required along with enhancement of host resistance [4]. In this context, silicon (Si) having beneficial effects on mechanical and physiological properties of plants, plays a pivotal role. Fawe *et al*. proposed that Si played an active role in reinforcing plant disease resistance by stimulating natural defense reactions [5]. Fauteux *et al*. explains that silicon alleviates abiotic and biotic stresses, and increases the resistance of plants to pathogenic fungi by mechanical support as well as modulation of the activity of intracellular signaling systems [6]. Efficient silicon uptake by the plants is the key behind its efficient working which is made possible only when plant functionings are energized to spend extra energy for up-taking Si from soil solution. And in turn this is possible when plants' metabolic activities are sound enough. With this background, organic package of practice under Inhana Rational Farming (IRF) Technology focuses on development of healthy plants to enhance the natural defense system of plants through its energy management principle. The working philosophy of IRF technology was in the line of Trophobiosis theory of Chaboussou which aimed towards development of healthy plants [7]. The technology was successfully demonstrated in sustainable organic management of several agricultural crops viz. paddy, pulses, baby corn and other vegetables and most importantly in large scale tea cultivation. The present study aims at effectiveness of disease management protocol under late blight infestation in potato.

MATERIALS AND METHOD

Study Area

The present study was undertaken in two villages of West Bengal, India viz., Mathurapur in Kowgachi-II Panchayat situated in district of North 24 Paraganas and Bhabanipur of Fatepur Panchayat situated in that of Nadia district (Figure 1). Both the study areas come under lower Gangetic plain region (III) according to Planning Commission (2007). Both the study aresa were under hot sub-humid (moist) to humid eco-sub region having annual rainfall of 1424.9 and 1385.3 mm for Mathurapur and Bhabanipur respectively, with maximum rainfall occurring during June-September and least during January-February. The mean annual maximum and minimum temperature fluctuates from 40.2 to 10.8°C and relative humidity ranges between 66 and 85%. The study was carried out in Rabi season when the temperature was recorded to fluctuate between 9 and 14°C with negligible rainfall.

Potato was extensively grown as an important cash crop in the study area and every year a considerable loss occurred due to late blight (causal organism: *Phytophthora infestans*) infestation. After discussions in farmers' meeting, regarding the limitations of the present conventional cultivation practice, some progressive farmers came forward to participate in the project for evaluating actual efficient disease management under conventional farming practice vis-à-vis non-chemical plant management following Inhana rational farming (IRF) technology.

Fig. 1: *Satellite View of Location of* ***(A)*** *Bhabanipur Village, Fatepur Panchayat, Nadia District and* ***(B)*** *Mathurapur Village, Kowgachi II Panchayat, North 24 Parganas District, West Bengal, India.*

Experimental Protocol

Under the study, adoptability of two packages of practice *viz.* conventional chemical farming (farmer's practice) and integrated farming using IRF technology (IRFT) were evaluated in terms of disease management (Table 1). In conventional farming (T_1), both soil and plant managements were done applying chemical fertilizers and pesticides. 1500 kg complex fertilizer (10:26:26), 375 kg SSP and 225 kg muriate of Potash (MOP) were applied per hectare as per recommended practice in the conventional chemical plots. Under integrated farming (T_2), 15 t Novcom compost and 375 kg complex fertilizer (10:26:26) were applied per hectare along with organic plant management as done according to IRF package of practice.

Two potato varieties viz. Kufri Jyoti and Kufri Chandramukhi were taken for the present study. Seed treatment was done in case of both the treatment. In case of conventional farming practice (T_1), Mancozeb (75% WP) was used for seed tuber treatment @ 2.5 gm/l water/kg seed. Potato seed tubers under integrated farming management practice were treated with seed solutions under IRF package of practice (@ 1 l Inhana seed solution for 500 kg of seeds.

Two rounds of copper oxychloride 50 WDP was sprayed @ 1 l/ha as prophylactic spray against late blight during 60 and 75 days after transplanting in T_1 plots. Once disease infestation symptom was first observed, two rounds of combination dose (Carbendazim 12% WP + Mancozeb 63% WP) were sprayed @ 1 kg/ha at an interval of 10 days. Under IRF package of practice (T_2) six rounds of spraying of different Inhana solutions from two to three leaf stages at an interval of 7 to 10 days were done. Details of IRF package of practice are given in Tables 2 and 3.

Principles of Pest Management as per Theory of Trophobiosis

According to Chaboussou, it is not just any plant which is attacked by pests and diseases, but only those which could serve as food for the insect or pathogen [7]. So, for a plant to be resistant, it is important to manage its growth in the correct manner. All factors which affect a plant's internal balance and functioning can lessen or increase its susceptibility to pest and disease attacks. Most pest and disease organisms depend for their growth on free amino acids, and reducing sugars in solution in the plant's cell sap. When offered free nutrients, pests/vectors of disease grow better and multiply faster (Figure 2).

Table 1: *Treatment Details.*

T_{1J}	:	Variety: Kufri Jyoti	Conventional Chemical Farming (Recommended dose of chemical fertilizers and chemical plant management).
T_{1C}	:	Variety: Kufri Chandramukhi	
T_{2J}	:	Variety: Kufri Jyoti	Integrated Farming under Inhana Rational Farming Technology (through integrated soil management and organic plant management following the Inhana Rational Farming (IRF) plant management practice).
T_{2C}	:	Variety: Kufri Chandramukhi	

Table 2: *Different Solutions Used for Disease Management under IRF.*

Sl. No	Solution Name	Dose and Dilution	Growth Stage (Time of Application)
1.	Seed treatment solution	200 ml for the tubers of one bigha and diluted in 200 l water.	Tubers were kept for 15–20 min in the diluted solution, then under shade for 5–10 min followed by planting in the field.
Potato Disease Management (Post Transplantation)			
1.	IB (Ag)-2 + IB(Ag)-7	(1.5 l + 1.5 l)/ha	To be sprayed on plants, on the 7th day after sprouting.
2.	IB (Ag)-12 + IB(Ag)-7	(1.5 l + 1.5 l)/ha	17th day after sprouting.
3.	IB (Ag)-11	1.5 l/ha	27th day after sprouting.
4.	IB (Ag)-2 + IB(Ag)-7+ IB (Ag)- -12	(1.5 l + 1.5 l +1.5 l)/ha	37th day after sprouting
5.	IB (Ag)-12	1.5 l/ha	47th day after sprouting.
6.	IB (Ag)-2 + IB(Ag)-7	(1.5 l + 1.5 l)/ha	57th day after sprouting.

Table 3: *Ingredients and Role of Inhana Solutions under IRF Package of Practice for Potato Cultivation.*

1.	**Seed Treatment Solution:** The solution is biologically activated and potentized extract of *Calotropis procera* R. and *Tinospora crispa* Miers. It plays role in initiation of metabolic resources during germination, faster independence of seedling from the seed reserve, photosynthesis enhancement and increased uptake of organic and inorganic solutes through roots.
2.	**IB (Ag)-2:** The solution is biologically activated and potentized extract of *Ocimum sanctum* L., *Calotropis procera* R. and *Cynodon dactylon* (L.) Pers. It acts as silica induced immunity against fungal attack. It activates plants' host defense mechanism through silica management providing structural defense against fungal pathogens. It also stimulates plants' immune system by activating the biosynthesis of different phenolic compounds having fungi-toxic property.
3.	**IB (Ag)-7:** The solution is biologically activated and potentized extract of *Ocimum sanctum* L. It stimulates root function, activates root growth/penetration and energizes soil in the root zone; thus, improving soil-plant relationship. It helps to develop soil CEC, energizes the production of micro-flora and bio-flora around the root zone, improves base saturation to the desired level and enhances root cation exchange capacity. It stimulates root growth and penetration by activating contact exchange capacity of root.
4.	**IB (Ag)-11**: The solution is biological activated and potentized extract of *Solanum xanthocarpum* Schrad and Wendl. and *Aristolochia indica* L. It helps to improve the movement of solutions by providing systemic presence to give structural integrity.
4.	**IB (Ag)-12**: The solution is biological activated and potentized extract of *Sida Cordifolia* Linn. and *Berberis asiatica* Roxb. Ex. Dc. It helps to improve the plant's capacity for starch synthesis.

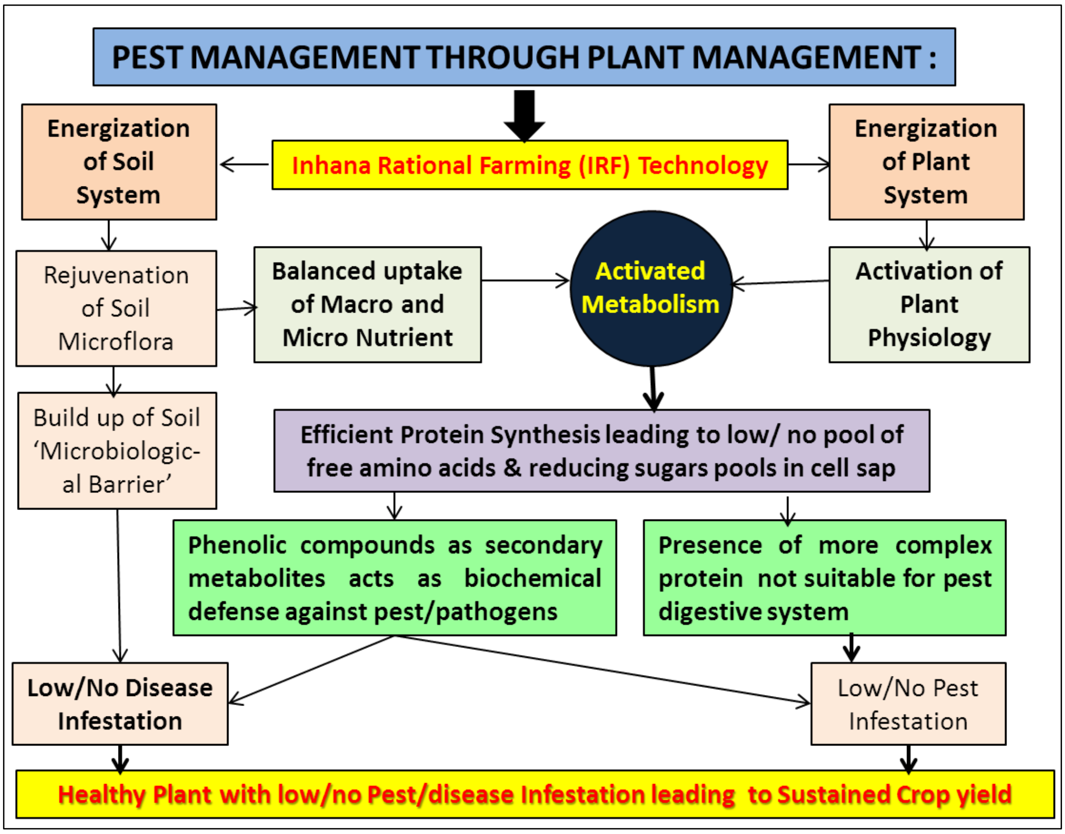

Fig. 2: *Flow Diagram of the Concept of Pest Management through Plant Management in Light of Trophobiosis Theory F. Chaboussou [7].*

Under conventional chemical practice, high fertilization creates susceptibility to pests, requiring more pesticides to control and thus almost all conventional chemical agricultural technologies create favourable conditions for the growth of pest and disease-causing organisms. In this sense therefore, agro-chemicals and poisons cause pests and diseases [8]. Whereas, focus on proper plant physiological functionings viz. photosynthesis and other plant metabolism can help to minimize free amino acids, and reduce sugars in cell sap while secondary metabolites produced through effective plant metabolism boost the biological defense system against pest/pathogens. At the same time, integrated soil management provides a slow nutrient release to plant system as well as helps to rejuvenate soil native microflora towards availability of both micro- and macro-nutrients as well as neutralized soil born pathogen infestation.

INHANA RATIONAL FARMING (IRF) TECHNOLOGY

Taking the essence of Trophobiosis theory, an Indian scientist, Dr. P. Das Biswas developed Inhana rational farming (IRF) technology which provides a nature receptive pathway for crop production taking into account the interrelated and integrated relationships of all the components of the ecosystem [9]. Objective of the technology is: (i) Energization of the soil system for its best portrayal as an ideal growth medium for plants and (ii) Energization of the plant system to become nutrition efficient in terms of optimum extraction, utilization and assimilation of nutrients as well as enhancement of their biochemical and structural defense leading to enhanced host- defense mechanism [10]. This farming technology has already been widely adopted in reputed tea estates in India and has shown its efficiency towards the reduction of chemical/pesticide load and management of recurrent disease problems (Figure 3).

- Immunosil provides the required energy for activated plant physiological activities viz. aerobic respiration and anaerobic glycolysis, which in turn provides the extra energy for effective absorption of silica, through the roots (Figure 4).
- This absorbed silica deposits as biogenic opal within the cell wall and thereby strengthens it against fungal invasion.
- Immunosil also activates the secretion of different phenolic compounds and other substances, which strengthens bio-chemical defense of the plants against fungal pathogens.

Study of Disease Infestation

The study was started in the conditions of a natural infection background. Field data were recorded for late blight of potato on 75 and 90 days. Plants under the treatment of conventional chemical farming and those subjected to integrated farming under IRF were observed for disease infestation. Number of plants infested in each plot was counted out of the total plants under both the treatments. In each plot, 270 leaves of 20 plants were selected randomly and the disease severity was assessed twice, i.e. 75 and 90 DAP as described in Table 4 where scale/grade was classified according to % of infestation following these symptoms described by British Mycological Society [11].

Fig. 3: *Landscape View of Integrated Farming Plots using IRF Package of Practice at Bhabanipur Village, Fatepur Panchayat, Nadia, W.B.*

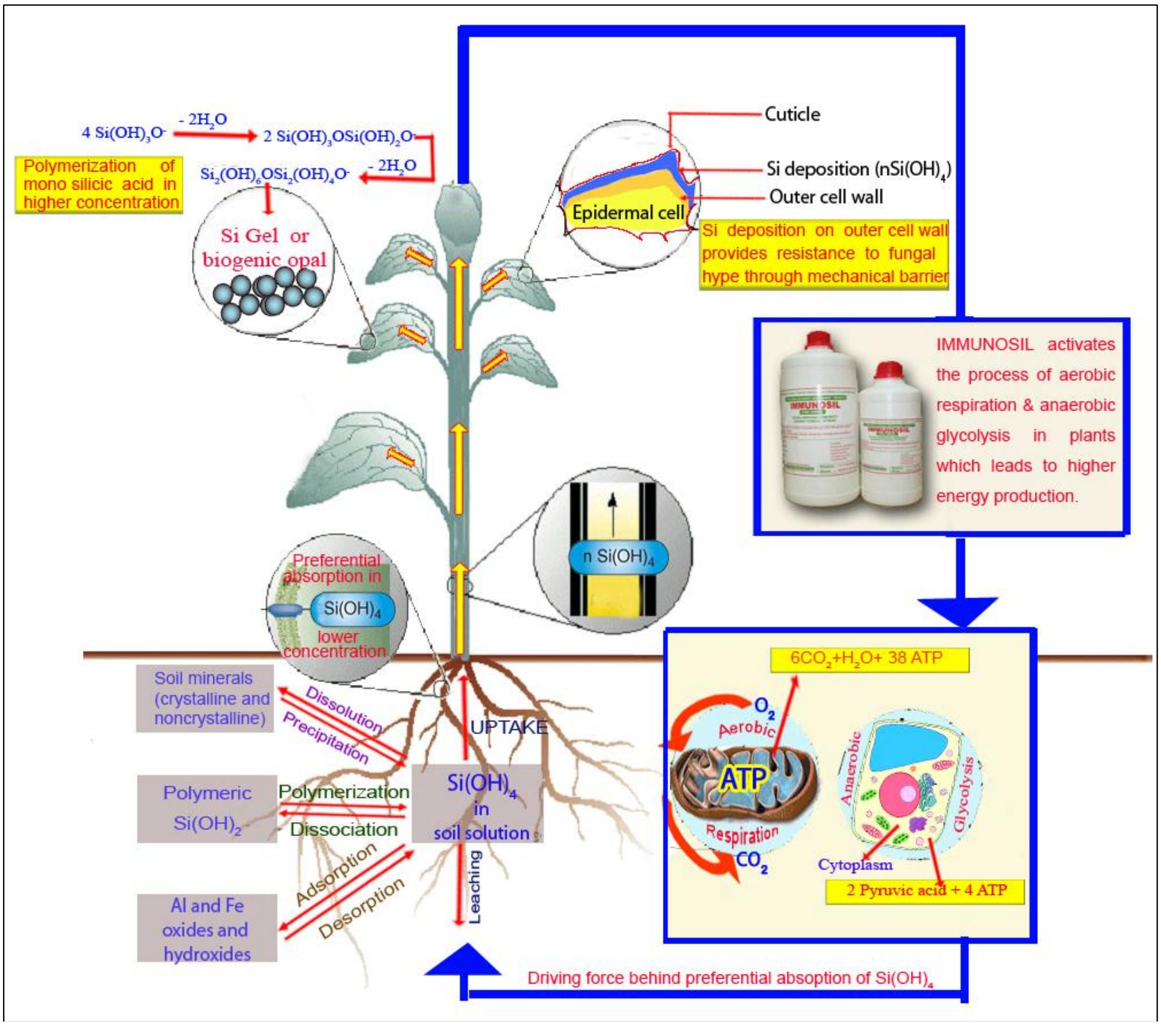

Fig. 4: *Mechanism of Immunosil (IB-2) for Plant Disease Management. (Management of Fungal Disease in Plants Requires Activation of Both Structural and Bio-Chemical Defense because Fungal Pathogens Infect Plants Much Before than its External Manifestation).*

Table 4: *Classification of Severity of Disease Infestation as per British Mycological Society [11].*

% Severity	Symptoms
0	Disease not seen in field.
0.1	Only a few plants affected here and there. Up to one or two spots in 10.8 m radius.
1	Up to ten spots per plant or general light spotting.
5	About fifty spots per plant or up to one leaflet in ten attacked.
25	Nearly every plant with lesions; plants still retaining normal form; fields may smell of blight but look green although every plant affected.
50	Every plant affected and about half of the leaf area destroyed by blight; field looks green flecked with brown.
75	About three-quarters of the leaf area destroyed by blight; field looks neither predominantly brown nor green. In some varieties, the youngest leaves escape infection so that the green is more conspicuous.
95	Only a few leaves left green, but stems green.
100	All leaves dead, stems dead or dying.

The severity of the disease was expressed in percent disease index (PDI), which was computed following a standard formula as described below [12]: Percent Disease Index (PDI) = [(Sum of all numerical grades)/(Total number of leaves examined × maximum grade)]×100

RESULTS AND DISCUSSION

Analysis of Disease Infestation

Counting of total late blight infected plants under both conventional chemical and integrated farming practice under IRF were done 90 days after planting in both Kufri Jyoti and Chandramukhi varieties (Table 5). In IRF treatment (T_2) plots, 340 plants were found to be with symptoms of late blight out of 4300 plants of Kufri Jyoti variety. Whereas under conventional chemical farming (T_{1J}), total 2867 plants out of 4300 plants were detected with late blight symptoms. So, only 7.91% of the population of potatoes was harmed in plots of integrated farming but in conventional plots, 66.67% of the plants were infected with late blight. Almost similar record was observed in case of Chandramukhi variety where also 2.82% plants were affected in T_{2C} while 49.44% was affected in T_{1C} plots (Figure 5).

Despite prophylactic spraying of copper oxychloride, late blight infestation could not be prevented in T_1 plots. This might be either because the appearance of new strains of pathogens that have become resistant to the available commercial fungicides or due to withering of its effect from the surface of the plants [13]. Besides, some reports appointed that application of fungicides has consequences on plant physiology, such as growth reduction, alteration of nitrogen, and/or carbon metabolism which is fundamental for plant culture and is reflected by mobilization of carbohydrate reserves [14, 15]. Lesser infestation of plants in T_2 plots can be attributed to the positive impact of Inhana solutions which aims at strengthening the plant physiology and increasing host defense mechanism.

***Table 5:** Late Blight Infestation Under Different Management Practices.*

Disease Infestation of Potato (Kufri Jyoti Variety); Age: 90 Days (total number of plants under observation was 4300 under each treatment)														
T_{1J}: Conventional Farming Practice	**Status**	**Farmer-1**			**Farmer-2**			**Farmer-3**			**Farmer-4**			**Total**
		Plot 1	**Plot 2**	**Plot 3**	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 1**	**Plot 2**	**Plot 3**	
	H. Plants	124	106	167	231	189	105	92	57	87	76	56	143	**1433**
	D.I. Plants	223	198	213	267	276	278	231	308	195	213	198	267	**2867**
	% infested	64.27	65.13	56.05	53.61	59.35	72.58	71.52	84.38	69.15	73.70	77.95	65.12	**66.67**
T_{2J}: Integrated Farming under IRF	**Status**	**Farmer-1**			**Farmer-2**			**Farmer-3**			**Farmer-4**			**Total**
		Plot 1	**Plot 2**	**Plot 3**	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 1**	**Plot 2**	**Plot 3**	
	H. Plants	234	287	326	345	287	387	342	407	347	279	316	403	**3960**
	D.I. Plants	2	0	12	23	0	47	14	47	26	33	59	77	**340**
	% infested	0.85	0.00	3.55	6.25	0.00	10.83	3.93	10.35	6.97	10.58	15.73	16.04	**7.91**
Disease Infestation of Potato (Variety: Kufri Chandramukhi); Age: 90 Days (total number of plant under observation was 5500 under each treatment)														
T_{1C}: Conventional Farming Practice	**Status**	**Farmer-1**			**Farmer-2**			**Farmer-3**			**Farmer-4**			**Total**
		Plot 1	**Plot 2**	**Plot 3**	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 1**	**Plot 2**	**Plot 3**	
	H. Plants	132	167	189	267	198	205	292	307	287	295	253	189	**2781**
	D.I. Plants	256	167	276	298	204	278	231	238	195	140	178	258	**2719**
	% infested	65.98	50.00	59.35	52.74	50.75	57.56	44.17	43.67	40.46	32.18	41.30	57.72	**49.44**
T_{2C}: Integrated Farming under IRF	**Status**	**Farmer-1**			**Farmer-2**			**Farmer-3**			**Farmer-4**			**Total**
		Plot 1	**Plot 2**	**Plot 3**	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 1**	**Plot 2**	**Plot 3**	
	H. Plants	434	487	410	445	427	414	421	507	447	479	471	403	**5345**
	D.I. Plants	2	0	43	13	0	0	0	32	0	0	48	17	**155**
	% infested	0.46	0.00	9.49	2.84	0.00	0.00	0.00	5.94	0.00	0.00	9.25	4.05	**2.82**

***Note:** H. Plants: Healthy Plants; D.I. Plants: Disease Infested Plants.*

***Table 6:** Record of % of Severity on the Leaves of 20 Randomly Selected Disease Infested Plants under Both Treatments.*

Treatments	**Percentage of Disease Severity on the Leaves of Potato Plant**								
	0	**0.1**	**1**	**5**	**25**	**50**	**75**	**95**	**100**
Study on 75 days Plant									
T_{1J}: Conventional Farming Practice	80 (29.6)	48 (17.7)	40 (14.8)	42 (15.5)	28 (10.4)	16 (5.9)	11 (4.1)	2 (0.7)	3 (1.1)
T_{2J}: Integrated Farming under IRF	124 (45.9)	113 (41.8)	11 (4.1)	9 (3.3)	13 (4.8)	0	0	0	0
Study on 90 days Plant									
T_{1C}: Conventional Farming Practice	50 (18.5)	28 (10.3)	25 (9.2)	12 (4.4)	38 (14.1)	56 (20.7)	41 (15.1)	11 (4.07)	9 (3.3)
T_{2C}: Integrated Farming under IRF	114 (42.2)	118 (43.7)	12 (4.4)	5 (1.8)	18 (6.6)	2 (0.7)	0	0	1 (0.3)

Figure in parenthesis indicates percentage of total number of leaves observed

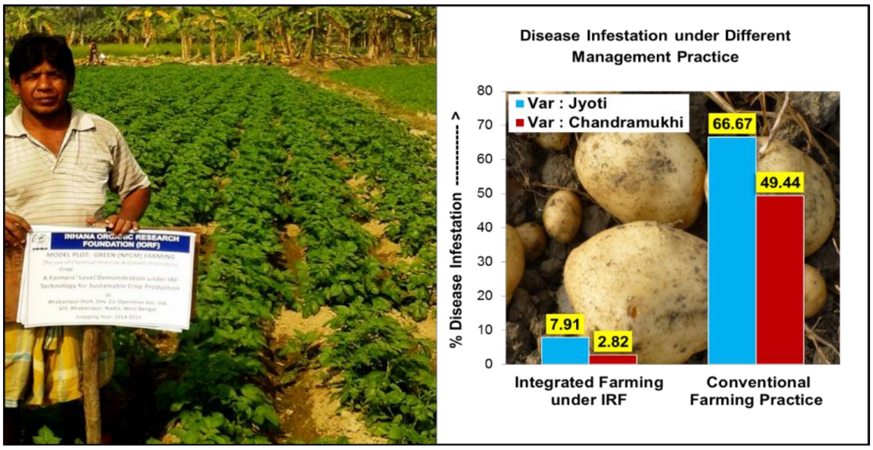

***Fig. 5:** Comparative Study of Disease Infestation Under Conventional Farming Practice and Integrated Farming Under IRF Package of Practice.*

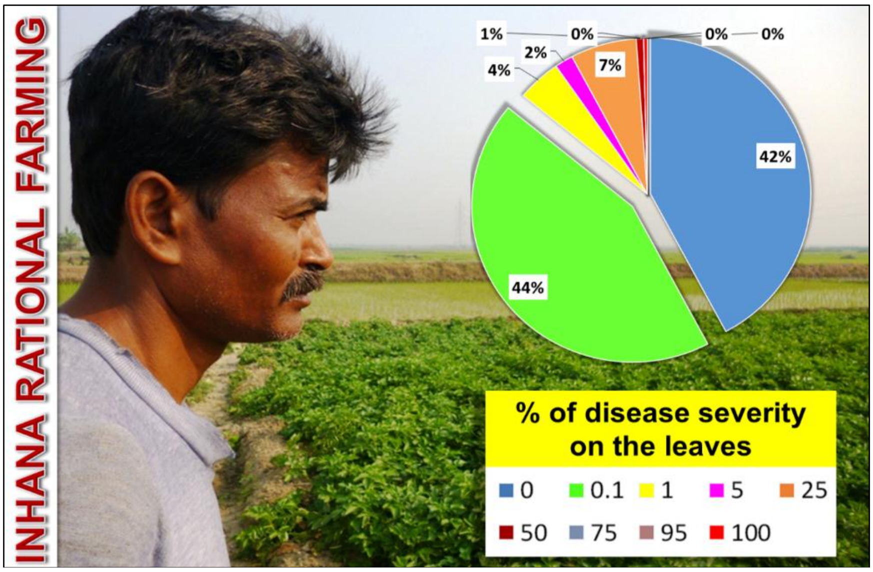

***Fig. 6:** Percentage of Disease Severity on the Leaves of Potato Plant under IRF Package of Practice in the Final Counting on 90 DAP.*

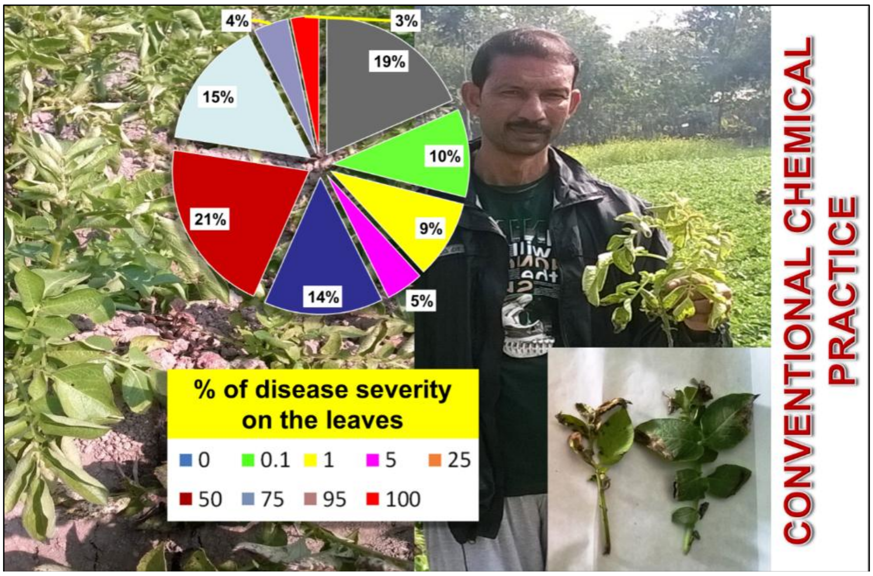

***Fig. 7:** Percentage of Disease Severity on the Leaves of Potato Plant under Conventional Chemical Farming in the Final Counting on 90 DAP.*

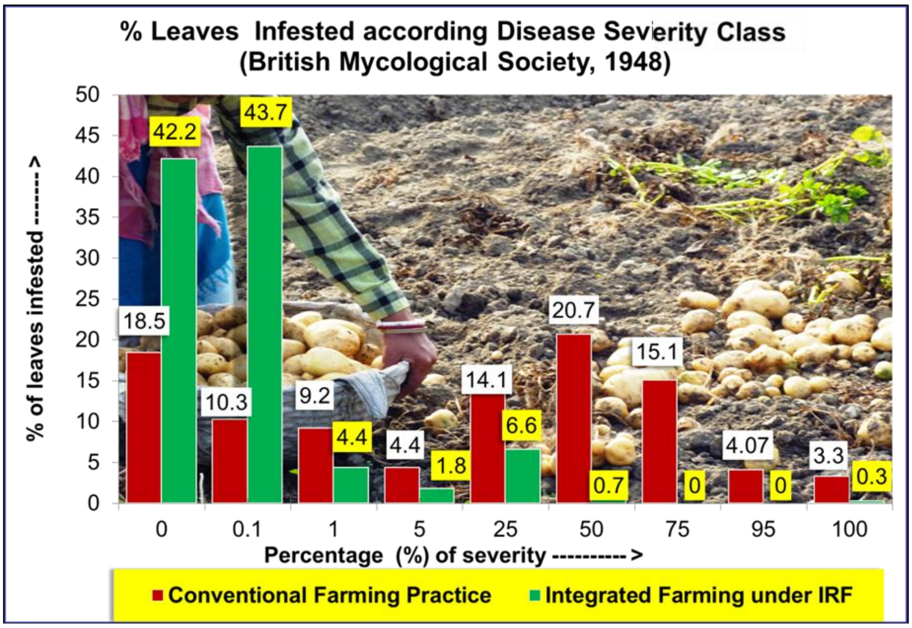

Fig. 8: *Percentage of Total No. of Leaves Infested by Late Blight Categorized Under Different Grades according to the % of Severity, Observed at 90 DAP.*

Comparing the data taken 75 and 90 DAP; no. of leaves with higher percentage of disease infestation increased gradually in both the treatments but the rate of infestation was slower in T_2 than in T_1 (Table 6). No. of leaves with 50% infestation increased 14.8% in T_1 but only 0.7% increment was observed in T_2 (Figure 6). Similarly, no. of leaves with 75% infestation increased 11% under conventional farming practice (Figure 7) while no increment was recorded in case of green farming plots. This proves the proficient effectiveness of Inhana Solutions on the plants. As mentioned in Table 3, IB- Ag 2 (Immunosil) being an energized and potentised solution, provides the required energy for effective absorption of silica by the plants which deposits in the cell wall thereby strengthening it. Fungal spores landing on the surface of the leaves faces physical resistance against its germination and thus cannot penetrate the surface cell. Thus, the rate of infestation slows down.

Figure 8 reveals that severity of potato late blight in T_2 plots following integrated farming under IRF package of practice was significantly lower than in T_1 plots where chemical fungicide was sprayed. In T_2 plots, 42.2% of infested leaves are uninfected, 43.7% had one or two spots here and there while no observation was recorded with 75% infestation but only 0.3% of total leaves observed were completely destroyed along with the death of the entire plant. This indicates overall mild infestation in T_2 plots where most of the symptoms on the leaves are negligible with few exceptions of mild severities. Whereas, 20.7% leaves were 50% infested in T_1 followed by 15.1% in 75% infestation class and 14.1 in 25% infestation class.

In 18.5% leaves, no infestation was marked and 10.3% of the leaves had 0.1% infestation. 3.3% leaves were categorized to be 100% infested which was significantly higher than that of T_2. This discloses the better condition of the plots receiving only Inhana plant management programme in T_2. In conventional farming practice, in spite of application of chemical fungicide the severity was much larger. The energized and potentised plant extracts of IRF technology activates plant physiological activities. IB-Ag 2 (Immunosil) brings out the maximum efficiency of aerobic respiration and anaerobic glycolysis of the plant systems by providing it with required energy. Utmost efficiency of respiration and anaerobic glycolysis serves the extra energy for effective absorption of silica through the roots [16].

This absorbed silica deposits as biogenic opal in between the cell wall and thereby strengthens the structural defense of the plant against any penetration of fungal spore for its germination. Concomitantly, this Inhana solution also stimulates the biosynthesis of different phenolic compounds and other phyto-toxic substances, which strengthens bio-chemical defense of the plants.

Percent Disease Index (PDI)

PDI is used for overall evaluation of disease resistance. Hence for assessing the severity of incidence, PDI of potato was worked out at 75 and 90 DAP, under both the treatments (Figure 9). Lower incidence of disease was recorded in the IRF integrated farming plots (Figure 10). At 75 DAP, PDI of conventional plots was calculated to be 11.37% (Figure 11) which became 32.81% at 90 DAP. On the contrary, PDI in IRF integrated farming plots was computed to be 1.45% at 75 DAP and 2.59% at 90 DAP. Contact fungicides are not taken up into the plant tissue and protect only the plant where the spray is deposited [17]. Massive increase of PDI in between 75 and 90 DAP in case of conventional farming plots (Figure 12) substantiated the non-competence of fungicides in late blight control resulting in rapid spread of the disease. On the contrary comparatively lower PDI and very minor increase in value with time demonstrated the efficiency of the alternate disease management protocol. Plant cell walls function as a first line of defense against pathogens by creating a physical barrier, which the pathogen must overcome in order to cause infection [18].

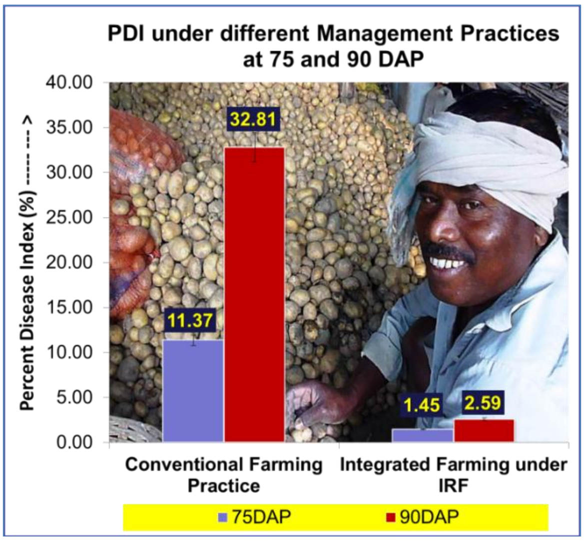

Fig. 9: *Percent Disease Index (PDI) of Potato Late Blight Under Both the Management Practices Recorded at 75 and 90 DAP.*

Fig. 10: *Lower Severity of Late Blight on the Infested Potato Leaves.*

Fig. 11: *Moderate Severity of Late Blight on the Infested Potato Leaves.*

Fig. 12: *High Severity of Late Blight on the Infested Potato Leaves.*

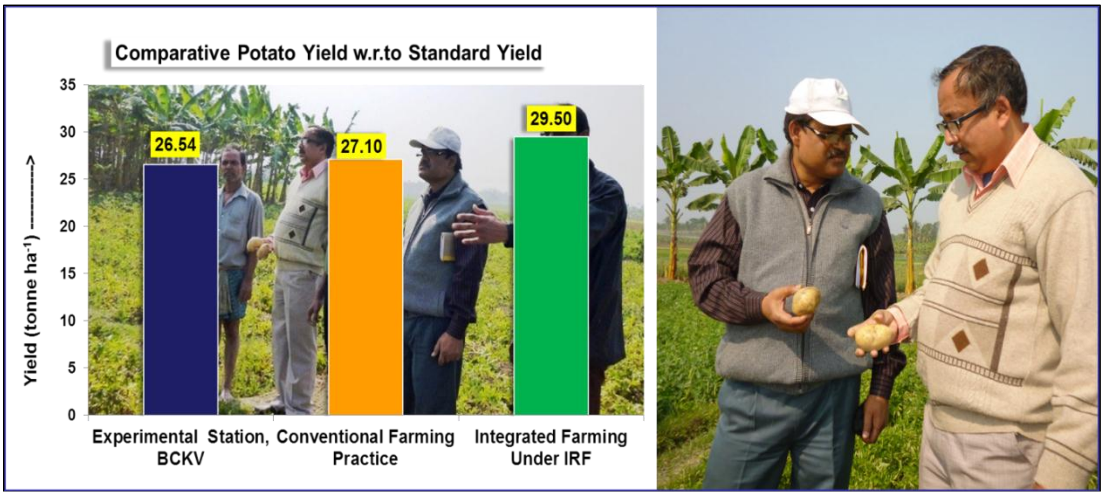

Fig. 13: *Prof. K. Sengupta, Head, Dept. of Agronomy (BCKV) and Dr. S.K. Roy, Dept. of Plant Pathology (BCKV) Inspecting Yield of Potato as Well as Size and Quality of Organic Potato Produced at Study Area Under IRF Package of Practice.*

As stated earlier, the potentised and energized botanical solutions under IRF technology provide energy to the plants towards efficient aerobic respiration and anaerobic glycolysis that is required for maximum absorption of silicon through roots. This silica deposits in the cell wall and toughens it further against fungal spore penetration thereby toughening the structural defense. Further protection is given by triggering the biosynthesis of phenolic and other phyto-toxic compounds which provide the biochemical defense.

Yield Performance

Figure 13 depicts the crop performance under conventional farming, integrated farming utilizing IRF technology and the standard yield of potato BCKV experimental station [19] that is close vicinity. Crop yield under integrated management was 8.86% higher than that recorded under conventional farming. However, when compared to the production IRF integrated farming, crop loss under conventional farming was comparatively lower (on an average 2400 kg/ha); despite very high severity of infestation. The minimal yield loss could have been influenced by the late infestation of the disease that is when the process of tuber formation was complete by a considerable extent.

CONCLUSION

The study brought forth the significance of plant physiology management towards successful management of late blight in potato. Restoration of soil health through reinstatement of the native soil microflora along with activation of plant physiological functioning can minimize the risk of disease infestation. At the same time, enhanced silicon uptake through energization of specific plant functions can help to activate both the structural and bio-chemical defenses of the plant that can minimize the severity of disease; an area where fungicides have absolutely no role, especially in case of late blight infestation. Thus, successful adoption of integrated farming under IRF technology can minimize the risk of potential crop loss even under late blight infestation and ensure economic sustainability for the farmers.

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