

Fungal Root Endophytes:

ROOTONIC (Fig 1a) is cultivable on solid (Fig 1b) and liquid semi-synthetic media (Fig 1c) and is suitable for large scale multiplication and conversion into a commercial agro-biological product. Till date we have treated over 148 diverse plant species including cereals, legumes, vegetable & horticultural crops and medicinal plants. Pronounced growth promotion was seen in all the plants tested at a varying level.

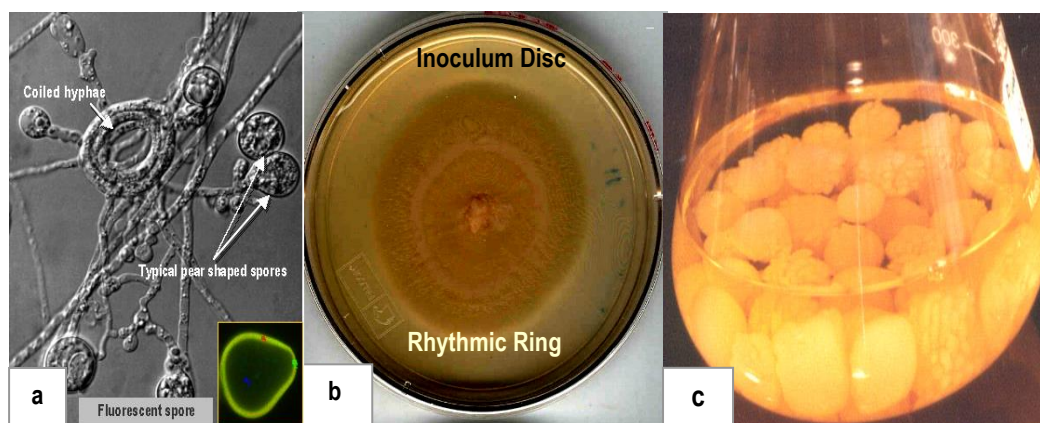


Fig 1. ROOTONIC

Plants of Industrial Importance

***Artemisia annua* (Fig. 2):** Interaction increased not only the biomass but also the Artemisinin (an anti-malaria drug) content.



Fig. 2

Control *P. indica*

Comment-
Control- Short Plants and light green leaves
P. indica treated tall and robust plants with dark green leaves

Fig. 3. Field Trial of *Artemisia annua* interacted with *ROOTONIC* at Pancmarhi MP India

Field trials of *ROOTONIC* interaction with *A. annua* have demonstrated increase in plant biomass as compared to control (Fig 3). The treated

plants were greener in colour as compared to the non treated ones. The field trial was performed at Madhya Pradesh Government experimental farm located at Panchmarhi, MP

Sugarcane

A filed trial was conducted on tissue culture raised sugarcane plants colonized with Rootonic in PAU, Ludhiana. Pronounced growth promotion was observed in treated plants as compared to control (Fig 4 and Table 1a). The ratoon crop had greener architecture and higher sugar content in treated plants as compared to control (Fig and Table 1b and 1c). The treated plants were more efficient in absorption of required micronutrients as compared to control.

Table 1a: Effect of Rootonic inoculation on yield attributing traits and yield of sugarcane crop

Treatments	Tiller number/ clump	Cane number/ clump	Cane height (cm)	Cane girth (cm)	Sugar content*	Weight per clump (kg)	Weight per plot (kg)
Control	6.18	5.10	178	2.18	16.78	4.95	121.9
Rootonic	8.43	7.72	202	2.15	16.85	5.85	135.3
% Change	36.4	51.3	13.4	-	-	-	11.5
CD (5%)	1.30	0.97	2.48	NS	NS	NS	3.76

***Brix Value**

Table 1b: Effect of Rootonic on nutrient acquisition of sugarcane ratoon crop

Treatments	Fe (ppm)	Mn ppm)	Cu (ppm)	Zn (ppm)	K (%)	P (%)
Control	202.2	25.0	4.9	1.87	0.24	0.086
Rootonic	281.4	30.2	10.8	1.31	0.40	0.088
% Change	39	20	120	-	-	-
CD (5%)	47.07	NS	0.88	0.33	NS	NS

Table 1c: Effect of Rootonic inoculation on yield attributing characters and yield of sugarcane ratoon crop

Treatments	Tiller number/ clump	Cane number/ clump	Cane height (cm)	Cane girth (cm)	Sugar content*	Weight per clump (kg)	Weight per plot (kg)
Control	9.27	8.10	179	2.22	18.35	6.50	122.2
Rootonic	17.2	15.90	191	2.21	21.40	7.34	138.3
% Change	85	96	6.7	-	16	-	13
CD (5%)	2.59	2.51	NS	NS	1.99	NS	2.39

***Brix Value**

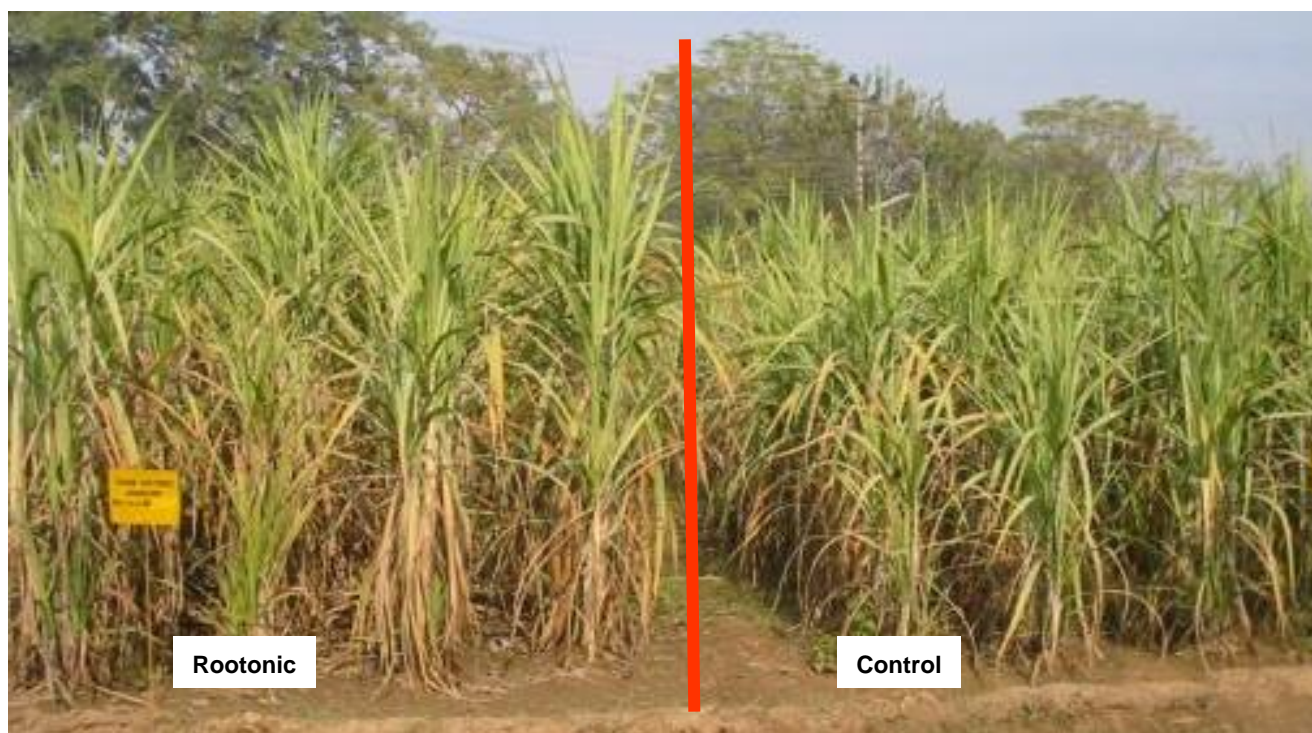


Fig. 4: Effect of Rootonic treatment in sugarcane.



Control
Dull Light Green Leaves
Symptoms of Iron Deficiency

Treated
Shining Bright Green Leaves
No Iron Deficiency

Fig. 5: Effect of Rootonic treatment in ratoon crop of sugarcane.

Disease Resistance

Bottle Gourd plants treated with Rootonic displayed better biocontrol as compared to untreated plants (Fig 6). 33.3 % increase in Yield and reduction in pesticide usage was observed in a trial conducted at Balachour, Distt SBS Nagar, Punjab.



Fig. 6. Effect of Rootonic inoculation on bottle gourd. The control field is yellow in colour as compared treated field, which is green in colour.

In Kinnow, Rootonic treatment resulted in resistance against viral infection. The Rootonic treated virus infected plants displayed re-initiation of flowering and fruiting as compared to untreated control (Fig 7).

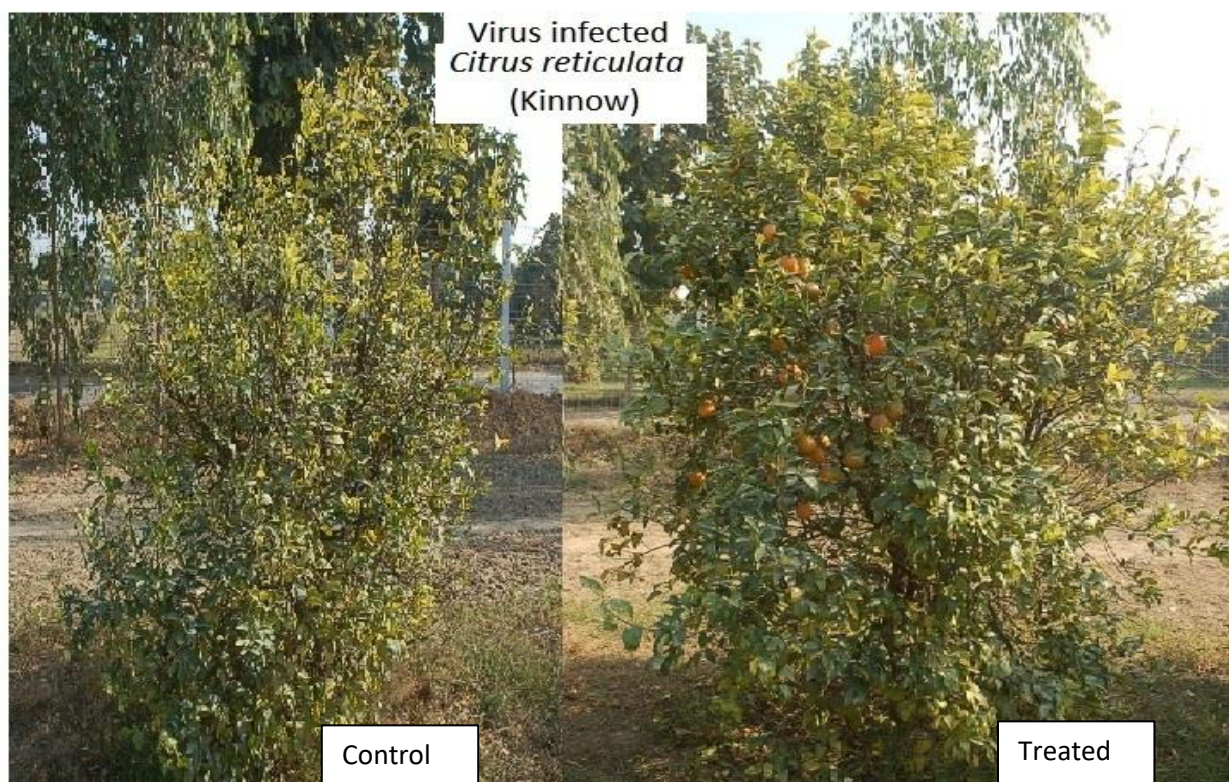


Fig 7: Rootonic injected at the root zone helped in recovery of virus infected plants

Enhancement of fungal biomass by incubation with nanoparticles:

Our recent experiments have indicated that inclusion of nanoparticle like titanium oxide or Carbon nano tubes considerably enhanced the biomass production (Fig 7 and Table 2)



Fig 7. Nanoparticle embedded fungal biomass further increase the plant growth.

Treatments	Fresh Biomass (g/100 ml)	Percent increase over control
Control (<i>ROOTONIC</i> only)	2.98	
TiO ₂ + <i>ROOTONIC</i>	4.12	38.25
CNT + <i>ROOTONIC</i>	3.86	29.53
Ag + <i>ROOTONIC</i>	3.48	16.77

Table 2: Enhancement of *ROOTONIC* biomass by nanoparticles
The culture filtrate of *ROOTONIC* also promotes plant growth and development (Fig. 8 a and b)

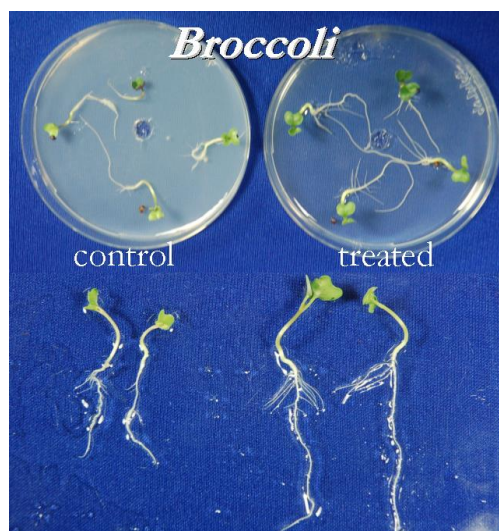


Fig. 8a

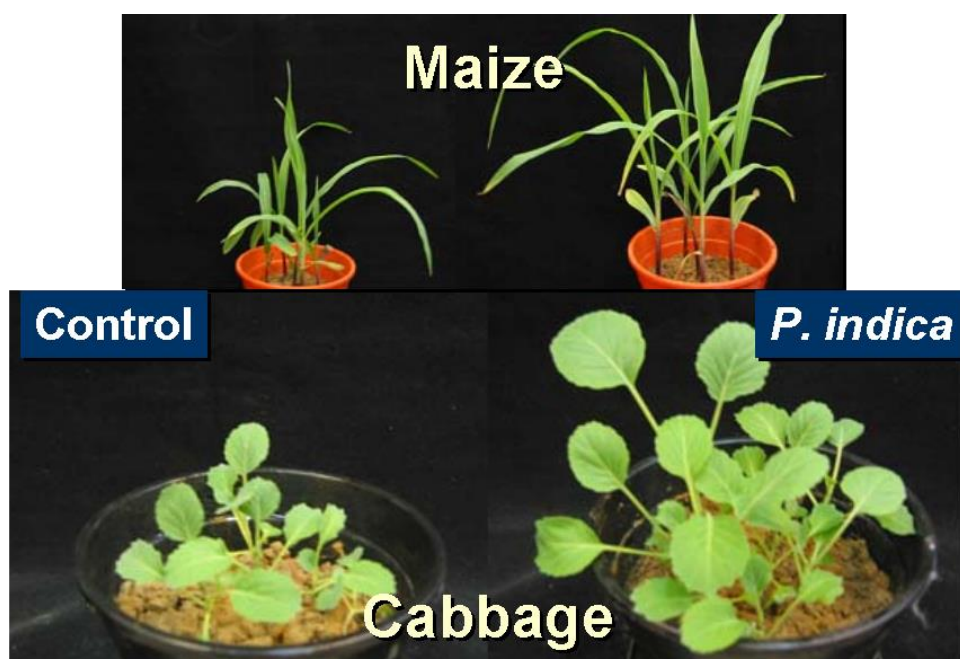


Fig. 8b

The various multifunctional role of *ROOTONIC* is outlined below (Fig 9):

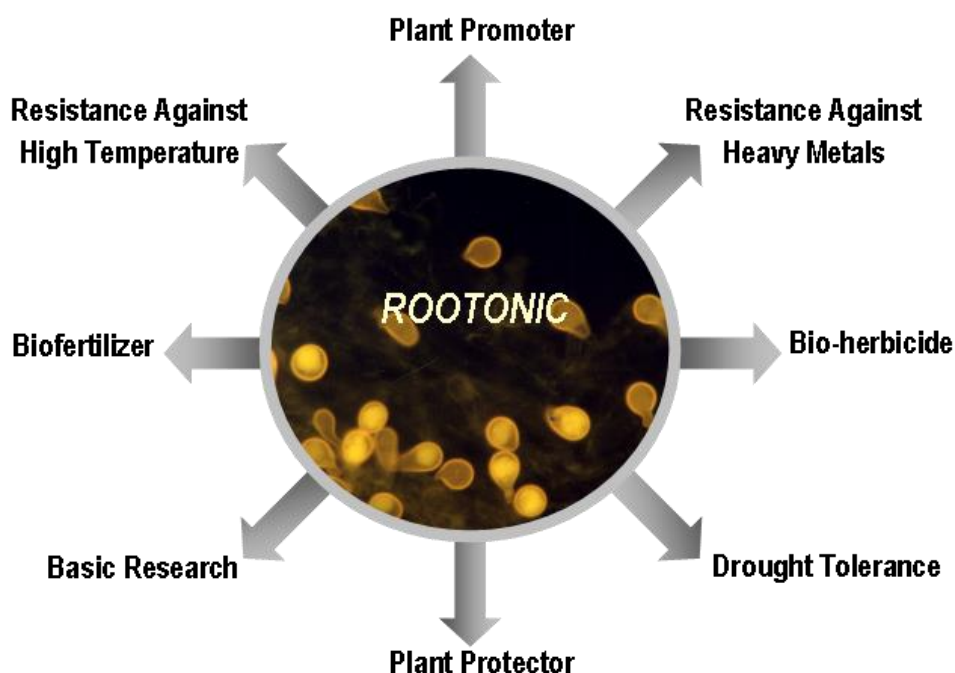


Fig 9. Multifunctional symbiotic fungus *ROOTONIC*

Breakthrough Findings

Although discovered in Thar desert, Rajasthan the fungus has shown cross talks with plants growing at highest possible place on earth i.e., the cold desert of Leh. The seeds interacted with *ROOTONIC* led to early seed germination (-18 °C) and enhanced growth at 4-10 °C as compared to control plants which were stunted in appearance (Fig 10).

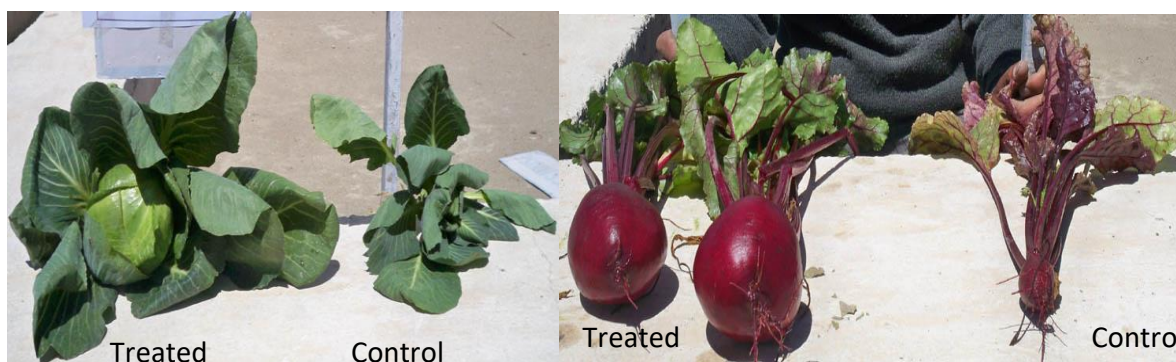


Fig 10. Cultivated plants at high altitude after *ROOTONIC* treatment. Pronounced growth promotion was seen after interaction as compared to control.

Summary:

Endophytic root colonization by *ROOTONIC* confers enhance growth to the host plant and provides protection against biotic and abiotic stresses. *ROOTONIC* enhances stress tolerance, confers disease resistance and increases yield in many crops. A summary of Rootonic field experiments conducted in various locations is given below in Table 3

S.N	Crop	Farmer/Office r Name and Place	Area	Yield (Quintals/acre)		% Change	Remarks
				Control	Treated		
1	Cotton	Sardar Prakash Singh Badal, Vill Badal, Distt Muktsar, Punjab	4 acres	7.2	6	20.00	The treated plants were healthier and were less affected by insects and pests as observed by farmer. The results were authenticated by Dr. Jallore Singh, ADO, Lambi
2	Maize	Sardar Gurdev Singh, Vill Sahouran, Distt SAS Nagar, Punjab	1 acre	28	24	16.67	On an average a yield of 14.64 % is reported after application of <i>P. indica</i> .
3	Maize	Sardar Jasbir Singh, Vill Sahouran, Distt SAS Nagar, Punjab	1 acre	26	23	13.04	Results Authenticated by Dr. Rajesh Kumar, ADO
4	Maize	Sardarni Jasbir Kaur, Vill Sahouran, Distt SAS Nagar, Punjab	1 acre	27	24	12.50	Results Authenticated by Dr. Rajesh Kumar, ADO
5	Maize	Sardar Avtar Singh, Vill Mampur, Distt SAS Nagar, Punjab	1 acre	25	22	13.64	Results Authenticated by Dr. Rajesh Kumar, ADO

S.N	Crop	Farmer/Office r Name and Place	Area	Yield (Quintals/acre)		% Change	Remarks
				Control	Treated		
6	Maize	SardarJoginder Singh, Vill Mampur, Distt SAS Nagar, Punjab	1 acre	27	23	17.39	Results Authenticated by Dr. Rajesh Kumar, ADO
7	Maize	Sardar Jagtar Singh Block Nurpur Bedi, Distt Ropa	1 acre	21.03	17.69	18.88	The treatment showed early flowering and increased pest tolerance. Cultivation performed under Rainfed condition. Project sponsored by DST SEED
8	Wheat	Shri KS Bains, Near Raja Sansi Airport	1 acre	19.68	21.85	11.02	More yield in treated plants
9	Wheat	ADO, Kharar, Dist SAS Nagar	1 acre	18.1	19.4	7.20	Results authenticated by ADO, Kharar
10	Wheat	Village Mullanpur, Distt Ludhiana	1 acre	18.4	15.4	19.48	Under BIRAC project
11	Tomato	Sardar Resham Singh, Vill Mukatramwala , Block Sultanpur, Distt Kapurthala, Punjab	1 acre	250	225	11.11	Growth Better in Treated, Pesticide Spray kept constant

S.N	Crop	Farmer/Office r Name and Place	Area	Yield (Quintals/acre)		% Change	Remarks
				Control	Treated		
12	Tomato	Sardar Massa Singh, Vill Mothawalan, Block Sultanpur, Distt Kapurthala	2 acres	230	210	9.52	Stem borer and whitefly infestation less in treated; Pesticide (Midda and Coragen) usage reduced by 50 % in treated
13	Egg Plant	Sardar Massa Singh, Vill Mothawalan, Block Sultanpur, Distt Kapurthala	1 acre	100	50	100.00	Stem borer and whitefly infestation 50 % less in treated; Pesticide (Midda and Coragen) usage reduced by 50 % in treated; Fruit quality good in treated with no white spot
14	Muskmelon	Sardar Gurmail Singh, Vill Badali, Block Lohian, Circle Shakot, Distt Jalandhar	1 acre	90	70	28.57	Results Authenticated by Horticulture Assistant
15	Bottle Gourd	Sardar Sohan Singh, Vill Jatpur, Block Balachour, Distt S.B.S. Nagar	1 acre	200	150	33.33	Results Authenticated by HDO

S.N	Crop	Farmer/Office r Name and Place	Area	Yield (Quintals/acre)		% Change	Remarks
				Control	Treated		
16	Bottle Gourd	Dr. Sukhvinder Singh, Potato Seed Farm, Kartarpur, Distt Amritsar	1 acre	100	80	25.00	Blight and Aphd attack in control; Pesticide spray M-45, Metalex reduced by 50% in treated; Treated fruit more sweet in taste
17	Pumpk in	Dr. Sukhvinder Singh, Potato Seed Farm, Kartarpur, Distt Amritsar	1 acre	80	70	14.29	White fly infestation less in treated; Pesticide (M-45) weekly spray in treated and every four day in control
18	Onion	Dr. Sukhvinder Singh, Potato Seed Farm, Kartarpur, Distt Amritsar	1 acre	6	5	20.00	Only for seed production
19	Potato	Dr. Sukhdev Singh, Potato Seed Farm Dhogri (Jalandhar)	5 marla	26.45	21.12	25.24	If the crops will be sown in the season i.e. in the first week of October then more observations can be noted
20	Turmer ic	Pradeep Singh, Vill Tapria Raniwala, Block Sudwa, Distt S.B.S. Nagar	1 kanal	117	104	12.50	Results Authenticated by HDO

S.N	Crop	Farmer/Office r Name and Place	Area	Yield (Quintals/acre)		% Change	Remarks
				Control	Treated		
21	Pea	Sh, Chuhal Singh, S/o Sh. Batan Singh, Vill Simbal Majra, Tehsil Balachur, District, S.B.S. Nagar	1 acre	26	24	8.33	Results authenticated by HDO Balachur
22	Mustard	Sardar Jagtar Singh, Block Nurpur Bedi, Distt Ropa	1 acre	8.43	5.38	56.69	Alternaria black spot infection was found less in treatment as compared to control. Cultivation performed under Rainfed condition. Project sponsored by DST SEED
23	Guar	Distt Hanumangarh	1 acre	3.5	3	16.67	Results authenticated by M/s Sunita Hydrocolloids Pvt Ltd. Jodhpur Rajasthan
24	Paddy	Village Mullanpur, Distt Ludhiana,	1 acre	19.5	16.8	16.07	Under BIRAC project

S.N	Crop	Farmer/Office r Name and Place	Area	Yield (Quintals/acre)		% Change	Remarks
				Control	Treated		
25	Linseed	Sardar Jagtar Singh, Block Nurpur Bedi, Distt Ropa	1 acre	5.78	3.47	66.57	Seeds of treated were more healthy and had a more prominent coloration. Early flowering was observed in the treated crops.

Our group has isolated a novel axenically cultivated plant promoting root endophyte fungus *Talaromyces albobiverticillius* (Fig 11, formerly known as *T. purpureogenus*) (HNB9). The fungus has shown various PGPR (Plant Growth Promoting Rhizosperic Microbes) properties like Phosphate, Zinc, Iron and Silica solubilization and auxin production (Fig 12 a and b). Our preliminary work in lab, greenhouse and farmers field has shown promising results in terms of plant growth promotion and tolerance to biotic and abiotic stresses. The fungal mycelia also secrete a unique red coloured pigments in the medium which may have many industrial and commercial value. HNB9 is found to be endophytic as it colonizes a variety of plants and exhibit plant promoting property in the early experiments conducted on oilseeds, cereals and vegetables.

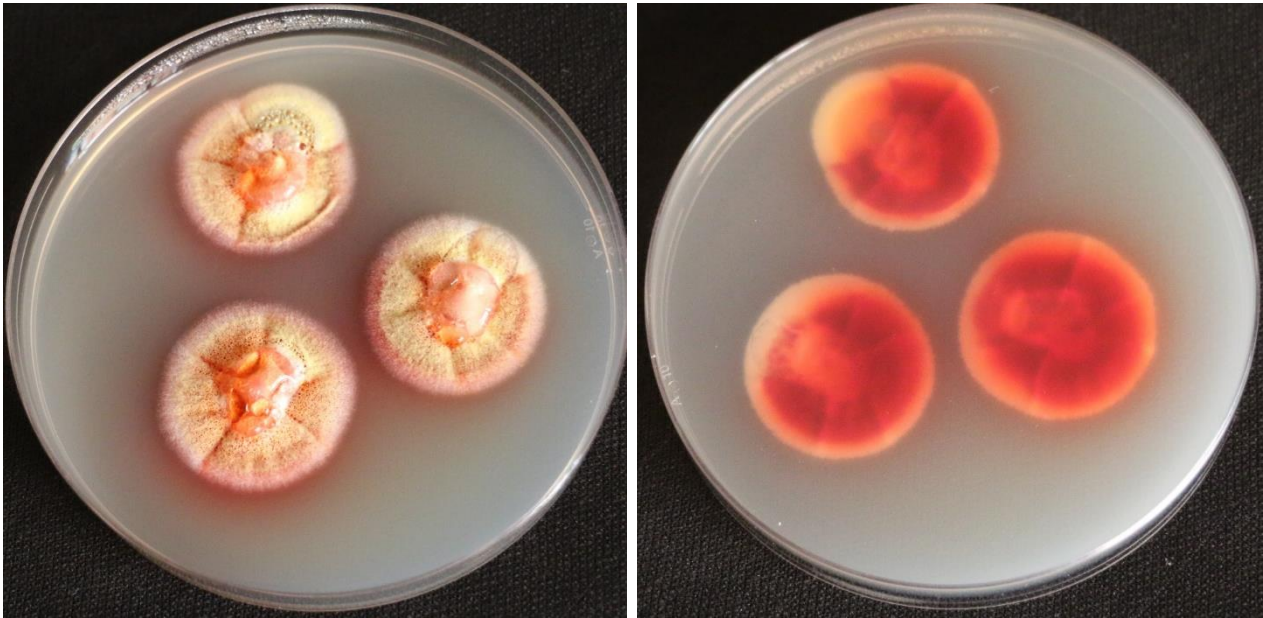


Fig 11: *Talaromyces albobiverticillius* HNB9 cultivated in PDA medium

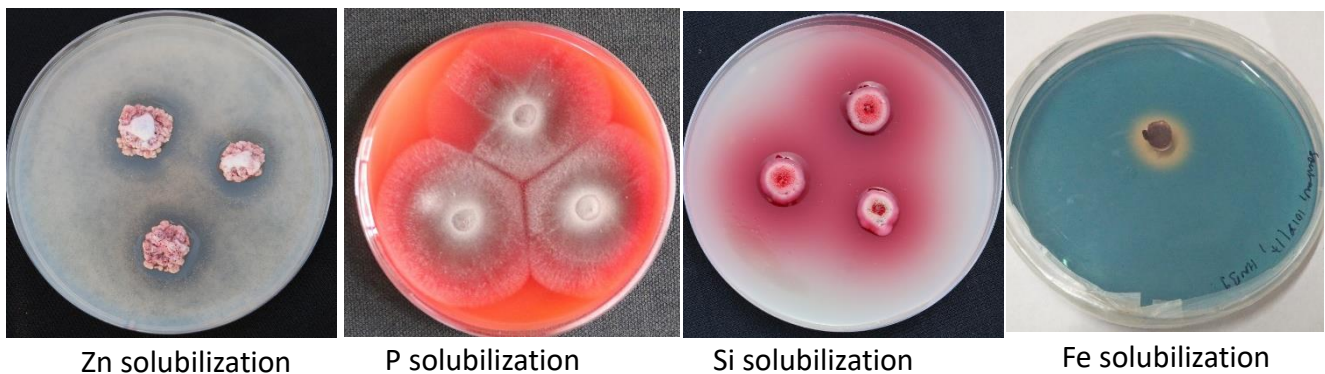


Fig12a: Various PGPRs attributes of HNB9.

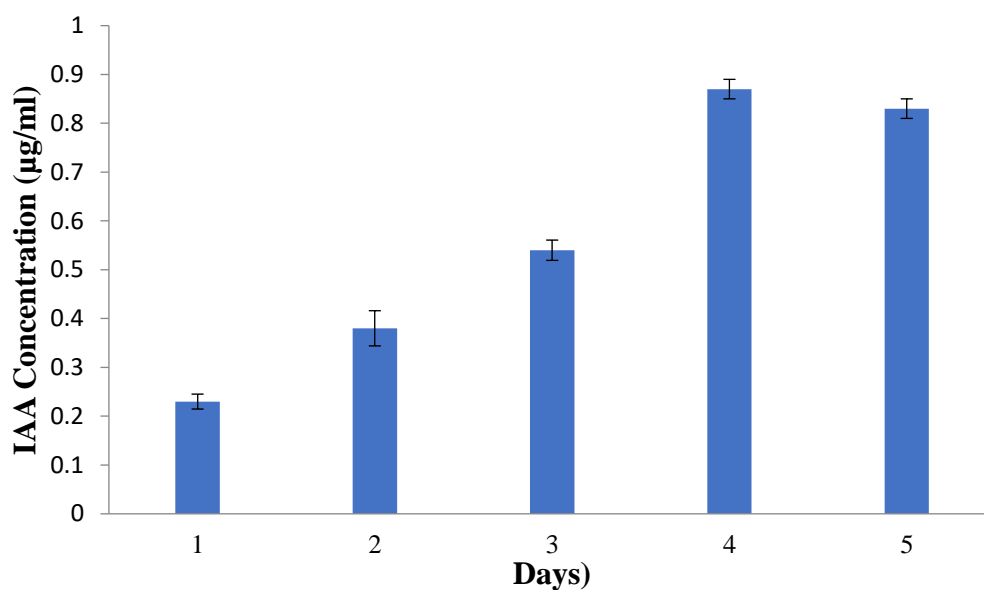


Fig12b: Auxin production by HNB9.

The fungus is non-toxic in nature as it tested negative for mycotoxin producing test in creatine sucrose agar medium (Fig 13).

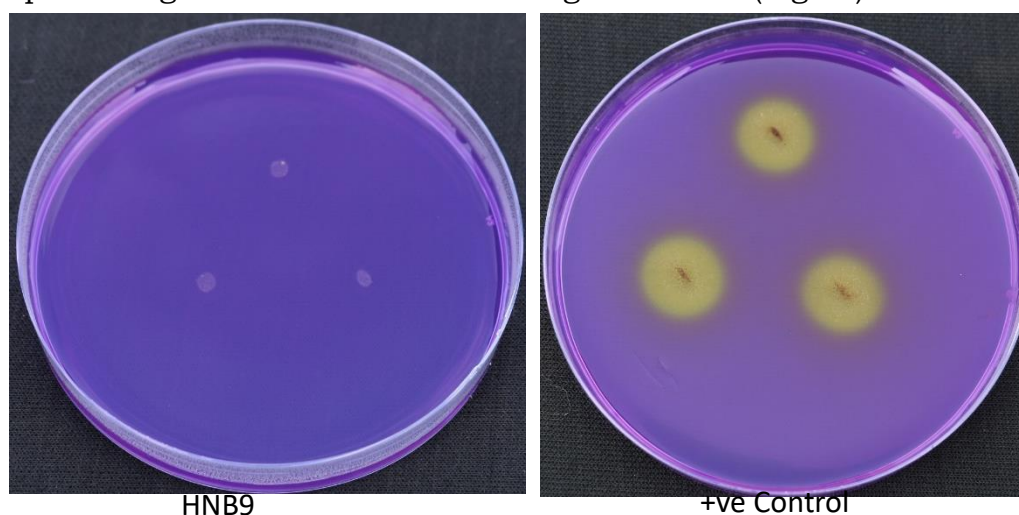


Fig 13: No growth of HNB9 on creatine sucrose agar medium.

The fungus is non toxic to plants as enumerated by seedling toxicity test (Fig 14a). Studies performed under *in vitro* and greenhouse conditions have shown growth promotion of plants (Fig 14 a, b and c) with profuse rooting.

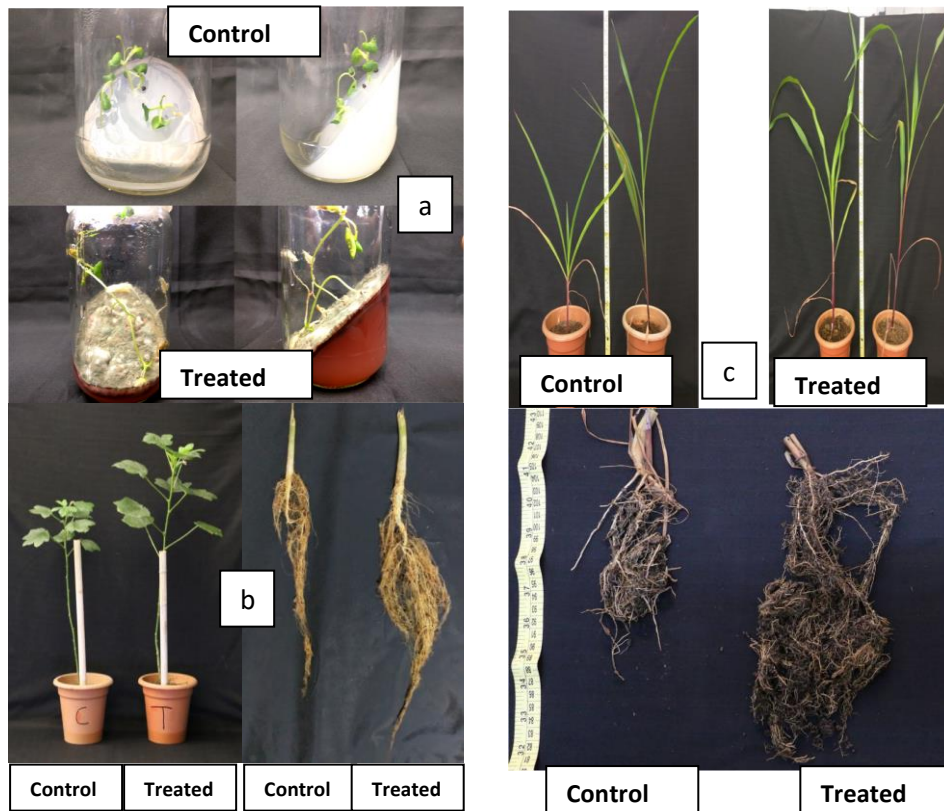


Fig 14: (a) Seedlings growing well on fungal mat without any inhibition of growth. (b) Shoot and Root growth promotion in okra in treated as compared to control. (c) Shoot and Root growth promotion in maize in treated as compared to control.

Upon interaction with seed, seedlings or standing plants, the fungal spores enters the root, colonize it and sends the fine hyphae outwards (Fig 15 a and b) and live symbiotically and helps in acquisition of various minerals and root growth by producing auxin a plant growth hormone.

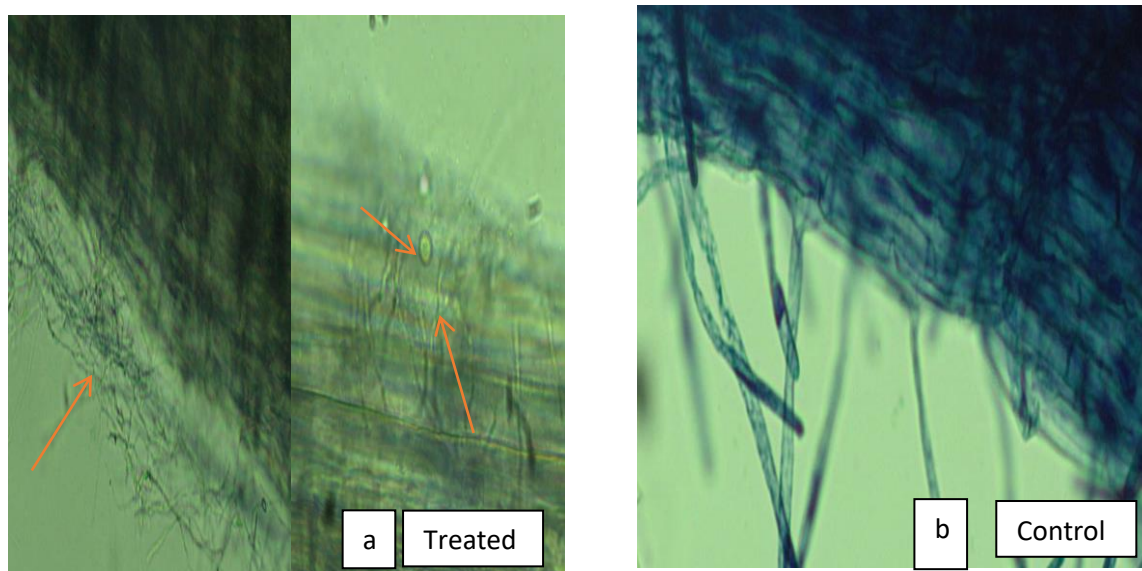


Fig 15: Treated: (a) Small thread like mycelia emerging from the roots; (b) spores and mycelia; **Control:** No mycelia emerging from the roots

In a microplot trial three wheat varieties treated with HNB9 showed significant increase in grains per year, thousand grain weight, grain yield, straw yield and hunger index as compared to control (Table 4 and 5).

Table 4: Effect of inoculation of HNB9 on growth of different wheat cultivars.

Treatments		Days to		Effective Tillers/m2	Plant Height (cms)		Ear Length (cms)
		50% Flowering	100% Flowering				
	Inoculations (I)						
Control (No Inoculation)		98.0	149.0	307.1	88.4		10.3
HNB9		97.7	149.4	320.4	87.0		10.2
CD (p=0.05)		NS	NS	NS	NS		NS
	Varieties (V)						
Unnat PBW 343		103.3	150.5	311.8	91.7		10.4
Unnat PBW 550		92.8	147.0	302.8	79.7		10.6
HD 3086		95.7	150.0	325.9	92.2		10.0
CD (p=0.05)		2.16	1.02	NS	2.21		NS

Table 5: Effect of inoculation of HNB9 on yield and yield attributes of different wheat cultivars.

Treatments	Grains per ear	Thousand Grain wt. (g)	Grain Yield (q/ha)	Straw Yield (q/ha)	Harvest Index
Inoculations (I)					
Control (No Inoculation)	47.96	42.69	53.69	80.15	0.40
HNB9	55.11	45.28	60.65	81.63	0.43
CD (p=0.05)	5.09	1.13	5.36	NS	NS
Varieties (V)					
Unnat PBW 343	52.60	45.42	56.94	77.93	0.42
Unnat PBW 550	59.45	41.96	58.48	71.95	0.45
HD 3086	46.77	45.74	61.30	88.68	0.41
CD (p=0.05)	3.21	1.67	3.25	5.43	0.024

In a farmer field trial sugarcane variety COO 118 treatment with HNB9 resulted in 15% yield enhancement in treated (490 qt/acre) as compared to control (425 qt/acre) (Fig 16).



Fig 16: Sugarcane field trial conducted at farmer's field.

In a farmer field trial rice variety PB1121 treatment with HNB9 resulted in 33% yield enhancement in treated (20 qt/acre) as compared to control (15 qt/acre) (Fig 17).



Fig 17: Rice field trial conducted at farmers field.

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Patents

- Novel and new nutrient for cultivation of *Piriformospora indica*. IPN. 944/DEL/2012, 27/03/2012, Granted.
- An improved method for controlling plant pathogen using *Piriformospora indica*. IPN 47/DEL/2015. 06/01/2015
- Plant Growth Promoting formulation of *Piriformospora indica* and *Azotobacter chroococcum* with talcum powder. PCT Application No.: PCT/IN2014/000447, 04.07.2014. PCT Patent published on 08/01/2015
- A system and method of endophytic activity of *Talaromyces purpureogenus* HNB9 . IPN. 201611035438, 14/10/2016, Filed and Published
- Method for preparation of culture filtrate of *Talaromyces purpureogenus* HNB9 for inhibition of *Fusarium oxysporum* ssp f. sp. *Lentis*. IPN 201911026194. 01/07/2019
- A system and method for biocontrol of wheat weed *Phalaris minor* by using plant growth promoting fungi *Talaromyces purpureogenus* HNB9. IPN 202011011882. 19/03/2020
- A method and formulation for plant growth promoting consortia of *Talaromyces purpureogenus* HNB9 and *Bacillus subtilis*. IPN 202111023165. 24/05/2021
- A method to establish the tripartite interaction between endophyte *Talaromyces purpureogenus* HNB9. IPN 202111023162. 24/05/2021



डॉ आर बी श्रीवास्तव
निदेशक,
वैज्ञानिक 'जी'

Dr. R. B. SRIVASTAVA
DIRECTOR,
SCIENTIST 'G'



रक्षा उच्च तुंगता अनुसंधान संस्थान
रक्षा अनुसंधान तथा विकास संगठन
रक्षा मंत्रालय, भारत सरकार
पिन: 901205, द्वारा 56 सेना पत्रालय

Defence Institute of High Altitude Research (DIHAR)
Defence Research and Development Organisation
Ministry of Defence, Government of India
Pin : 901 205, C/o 56 APO

दिनांक/Dated 26 Sep 2011

120/1/ARU/DIHAR

To Whom So Ever It May Concern

This is to certify that Symbiotic plant promoting Fungus *Pirifomospora indica* developed by Scientists of Amity University, Uttar Pradesh, Noida, U.P. was inoculated for its symbiotic interactions with seeds of 15 vegetables at Defence Institute of High Altitude Research, DRDO Leh-Ladakh during extreme subzero conditions at winter. The experiments were conducted in Polyench green house of the laboratory. The temperature ranged from -18 to +4°C. Within 12-25 days treated seeds were germinated. (Table No. 1) On transferring the seedlings to microplot led to production of large Cabbage and Cauliflower heads, Beet root, Carrot and Turnip roots. (Figs. 1 to 5) In Contrast, untreated seedlings were lagged behind. A microscopic view of fungal hyphae and spores is given in Fig. 6 a, b.

DIHAR is planning to treat millions of vegetable seeds with *Pirifomospora indica* and supply to farmers of Ladakh to increase fresh food availability at Ladakh region. It is an excellent micro-organism for mass production of green vegetables and will promote the Socio-economic conditions of Ladakh region.

Dr. R B Srivastava
Director, DIHAR

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ਅਗਲੇ 2/31 ਸਾਰੇ ਤੋਂ ਪਿੰਡ ਚਾਰੇ ਪਿੰਡੇ ਪ੍ਰਸਾਰ
 ਫ. ਪ੍ਰਸਾਰ ਪ੍ਰੀਮ ਚਾਰੇ ਦੇ ਕਾਰਨ ਤੋਂ ਪ੍ਰਫਲ ਕਾਟਕਾਟੀਕਤ
 ਹੋਵੇਗਾ. ਪ੍ਰਸਾਰ. 0.3028 ਮਿੰ ਪ੍ਰਫਲ ਤੋਂ ਪਿੰਡੇ
 P.F.S. (Pireformospora indica) ਪ੍ਰਤੀਰਿਮਾ. ਜੀ. ਸਿਧਾਂਤ
 ਕ. ਰੂਪ ਪ੍ਰੀਮ ਪ੍ਰਤੀਰਿਮਾ ਹੋਵੇਗਾ ਤੇ ਅਧਿਕਾਰਤ ਜੀ. ਹੋਵੇਗਾ
 ਫਿਰ 6 ਹੋਵੇਗਾ ਪ੍ਰਤੀ ਹੋਵੇਗਾ ਜੀ. P.F.S. 1 ਸਿਧਾਂਤ ਤੋਂ ਪਿੰਡੇ
 ਹੋਵੇਗਾ 7.20 ਹੋਵੇਗਾ ਪ੍ਰਤੀ, ਹੋਵੇਗਾ ਪਿੰਡੇ।

Deen
 26/12/2011
 ਪ੍ਰਤੀਰਿਮਾ

ਖੇਤੀਬਾੜੀ ਵਿਭਾਗ ਕਰਮਚਾਰੀ
 ਬਿਲਵੰਗਰਾ

26th December 2011

CERTIFICATE

It is certified that in Village Badal, at the farm of Sardar Prakash Singh Badal, 5 acres of cotton, variety OM 3028, was cultivated as "control" and another 5 acres, treated with *Piriformospora indica* (PSFI). Shri. Roop Singh, was Field In-charge and Observer. In the control (non-treated fields) the yield was 6 quintiles per acre and in the fields treated with PSFI, the yield was 7.20 quintiles per acre.

Sd, For

Dr. Jallore Singh

Agriculture Development Officer

Gidharbaha, Distt. Mukhtsar

Result of Demonstration Plot of Maize Crop treated with *Periformaspora Indica*
Block Kharar
District Sahibzada Ajit Singh Nagar

Sr No.	Name of Farmer	Father's Name	Village	Area (acre)	Yield of Plot treated with <i>Periformaspora Indica</i>	Yield of plot not treated with <i>Periformaspora Indica</i>
1.	Gurdev Singh	Pala Singh	Sahouran	1 acre	28 qtls per acre	24 qtls per acre 16.66
2.	Jasbir Singh	Pala Singh	Sahouran	1 acre	26 qtls per acre	23 qtls per acre 13.04
3.	Jasbir Kaur	W/o Gurdev Singh	Sahouran	1 acre	27 qtls per acre	24 qtls per acre 12.5
4.	Avtar Singh	Sadhu Singh	Mamupur	1 acre	25 qtls per acre	22 qtls per acre 13.63
5.	Joginder Singh	Gurdeep Singh	Mamupur	1 acre	27 qtls per acre	23 qtls per acre 14.37

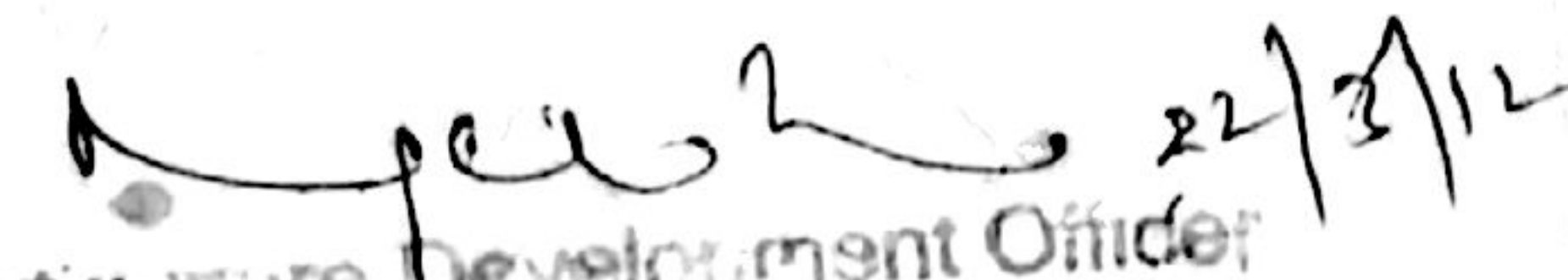
14.64
Agriculture Officer,
Kharar


S:
H:
V:

PFSI treatment Report

Sh. Chuhar Singh & Sh. Batan Singh
resident of Village Simbal Majara
Tehsil, Balachaur, District - Shahd
Bhagat Singh Nagar treated his
pea crop seed with PFSI. After
sowing he got 2 Q increase in
yield of crop. He got 26 Q yield
of crop which was already 24 Q.
without treatment of PFSI.

C/S

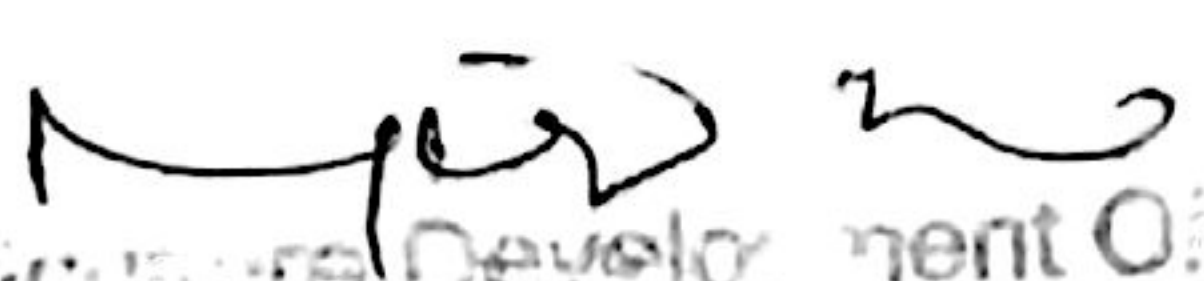
 22/3/12
Horticulture Development Officer
BALACHAUR P.H.S.-1
Dist. S.B.S. Nagar

 22/3/12
CHUHAR SINGH & BATAN SINGH
VILLAGE- SIMBAL MAJARA
TEHSIL- BALACHAUR
DISTRICT- S.B.S. NAGAR

PFSS Treatment Report

Sh. Pradeep Singh s/o Harjinder Singh resident of village- Taprian Ranjail Tehsil - Balachaur dist. Shaheed Bhagat Sing Nager, treated his turmeric crop seed with PFSS. After showing his turmeric result he got 1.65 Q increase in yield of crop. He got 14.65 Q yield of crop treated with PFSS and with out treatment of PFSS, he got 13 Q yield of crop

C/s

 28/5/12
horticulture Development Officer
B1 AGRI. S. H.S.-1
Taprian Ranjail

Pradeep Singh
NAME - Pradeep Singh
s/o Harjinder Singh
village - Taprian Ranjail
Tehsil - Balachaur
Distt. - Shaheed Bhagat
Singh Nager

Amity Institute of Microbial Technology

Amity University Uttar Pradesh

Farmer Feed Back Form for Result of PFSI Testing

Farmer Name & Address	Crop	Date of Sowing	Percent Germination	Date of Harvesting	Yield		Remarks if Any
					Treated	Control	
Sardar Sohan Singh s/o Hazara Singh Vill Jatpur Block Budochor Distt S.B.S. Nagar 01885-220338	Ghiya T = 5 Acre C = 1 Acre	March 1st Week	T = 90% C = 70%	Ongoing	20 Ton /Acre	15 Ton /Acre	M-45 Seven Spray Whitefly T = Less C = More T = Weekly Spray C = Spraying 4 days

[Signature]

Signatures

Farmer: _____

Dr. Amit C Kharkwal: *[Signature]*
Sr. Lecturer, AIMT

Date: 9/8/11

Government Official: *[Signature]*
H.S.I. Mounshah

Amity Institute of Microbial Technology

Amity University Uttar Pradesh

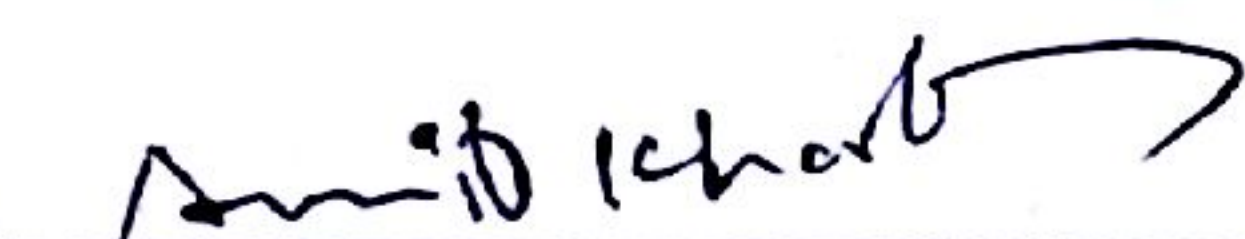
Farmer Feed Back Form for Result of PFSI Testing

Farmer Name & Address	Crop	Date of Sowing	Percent Germination	Date of Harvesting	Yield		Remarks if Any
					Treated	Control	
Dr Sukhvinder Singh Potato Seed Farm Kartarpur	Bottle Gourd Pb Komal T = 2 Acre C = 1 Acre Morla	March 10, 2011	T = 80% C = 70%	July Ist week 2011	100 kg/Acre	80 kg/Acre	

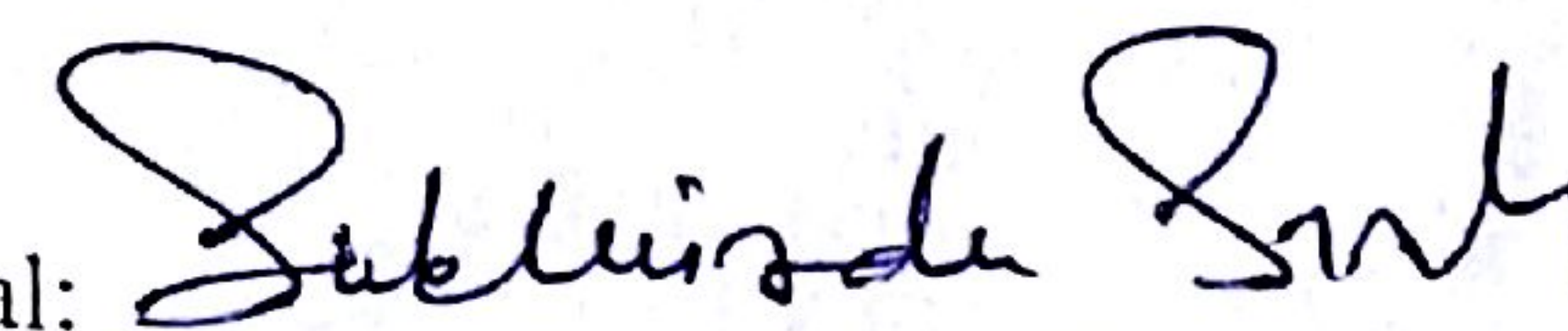
Signatures

Farmer: _____

Dr. Amit C Kharkwal:
Sr. Lecturer, AIMT



Government Official:



Date: 10/8/11

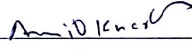
Amity Institute of Microbial Technology Amity University Uttar Pradesh


Farmer Feed Back Form for Result of PFSI Testing

Farmer Name & Address	Crop	Date of Sowing	Percent Germination	Date of Harvesting	Yield		Remarks if Any
					Treated	Control	
Sardar Mussa Singh	Baigan	2nd March Seedling T: 1.5 C C: 4 C	—	Angara	15 wtg/1.5c	7.5 wtg/1.5c	Seedling T: 50% less white fly T: 50% less Fruit Quality: Good; No white spot Post, side Spray: Half T: 15 spray; C: 2 spray

Signatures

Farmer: 

Dr. Amit C Kharkwal: 
Sr. Lecturer, AIMT

Government Official: 

Date: 8/8/11

Block E 3, 4th Floor, Sector 125, Noida, UP, 201303

Amity Institute of Microbial Technology

Amity University Uttar Pradesh

Farmer Feed Back Form for Result of PFSI Testing

Farmer Name & Address	Crop	Date of Sowing	Percent Germination	Date of Harvesting	Yield		Remarks if Any
					Treated	Control	
Sardar Gurmail Singh Badali Vill Block Lohian Circle Shakot Distt Jalandhar	Kharbuja T = 3 Killa C = 6 Killa Nandhari 910	2nd week March 2011	T = 100% C = 70%	2nd week June	90 q/tl	70 q/tl	Blight in control Treated fruit more sweet <u>Spray</u> M-45, Metalex Aphid, Bligh T = 1 spray C = 2 spray

Signatures

Farmer: Gurmail Singh

Dr. Amit C Kharkwal: Amit Kharkwal
Sr. Lecturer, AIMT

Date: 8-8-11; 12.45 PM

Government Official: Balwinder Singh
H.D.O.
Shakhat
99157-05815

Amity Institute of Microbial Technology

Amity University Uttar Pradesh

Farmer Feed Back Form for Result of PFSI Testing

Farmer Name & Address	Crop	Date of Sowing	Percent Germination	Date of Harvesting	Yield		Remarks if Any
					Treated	Control	
Dr. Sukhvinder Singh Potato Seed Farm, Kartarpur Distt. Jalandhar	Onion T = 1 Acre C = 1 Morla var ADR	15th March 2011	T = 80% C = 75%	June 1st Week	6 QTI/Acre	5 QTI/Acre	Fusarium wilt incidence 2% in T 5% in C

Signatures

Farmer: _____

Dr. Amit C Kharkwal: *Amit C Kharkwal*
Sr. Lecturer, AIMT

Government Official: *Sukhvinder Singh*

Date: 10/8/11

Amity Institute of Microbial Technology

Amity University Uttar Pradesh

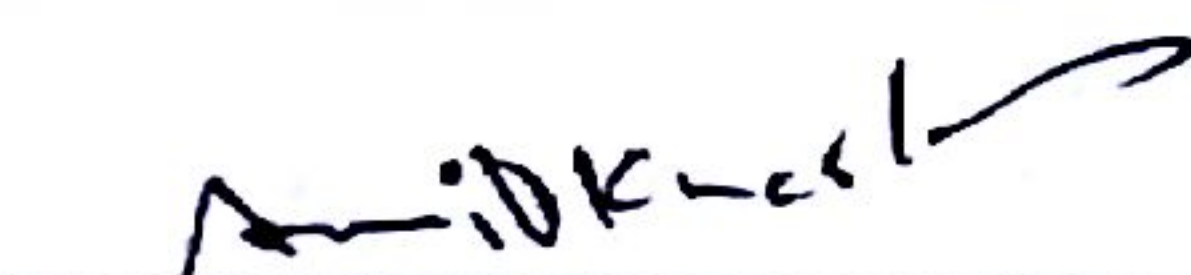
Farmer Feed Back Form for Result of PFSI Testing

Farmer Name & Address	Crop	Date of Sowing	Percent Germination	Date of Harvesting	Yield		Remarks if Any
					Treated	Control	
Dr Sulchinder Singh Potato Seed Farm	Pumpkin Sb Kaddu Punjab NO1 T = 1 Acre C = 1 Marla	15 March 2011	T = 80% C = 70%	July 1st week	80 kg/Acre	70 kg/Acre	

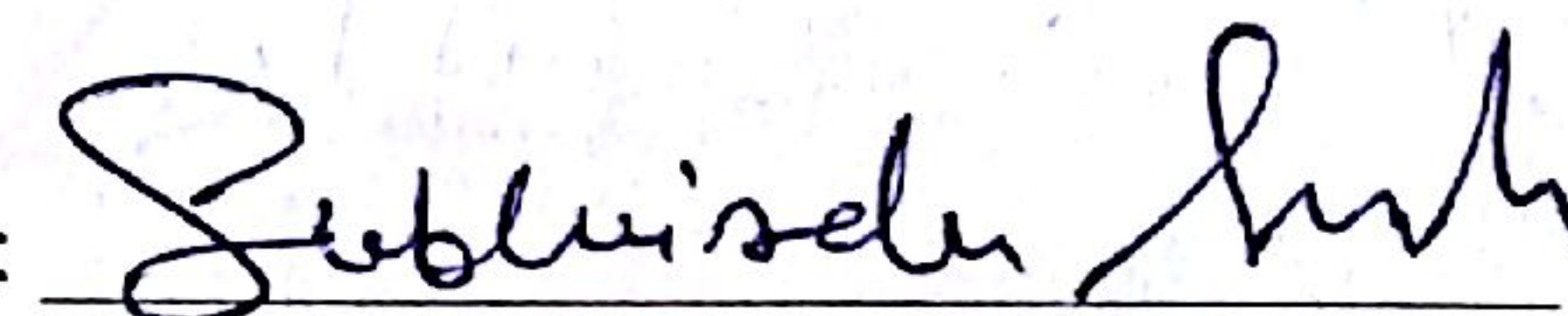
Signatures

Farmer: _____

Dr. Amit C Kharkwal:
Sr. Lecturer, AIMT



Government Official:



Date: 10/8/11

Amity Institute of Microbial Technology

Amity University Uttar Pradesh

Farmer Feed Back Form for Result of PFSI Testing

Farmer Name & Address	Crop	Date of Sowing	Percent Germination	Date of Harvesting	Yield		Remarks if Any
					Treated	Control	
Sardar Mussa Singh Vill Motowalon Block Sultanpur Distt. Koppur Malu	Tomato	2 nd March 2011 Seedlings T: 1C C: 1C		June last week	23 qtl	21 qtl	T: Sundi (stem bore) white fly infestation less: Spray mikka, Karan Koragan 1/2 usage

Signatures

Farmer: सर्दार मुसा सिंह

Dr. Amit C Kharkwal: Amit C Kharkwal
Sr. Lecturer, AIMT

Government Official: [Signature]

Date: 8/8/11

**DIRECTORATE OF AGRICULTURE
HIMACHAL PRADESH**

No.Agr.H(II-Tech)F(7)24/2006.

Dated: Shimla-5, the **2 NOV 2011**

From

Director of Agriculture
Himachal Pradesh

To

Shri P.Mitra
Addl. Chief Secretary (Agri)
to the Government of Himachal Pradesh, Shimla-2

✓ Dr. K.S.Bains
Director General
Amity Institute, Noida.

Dr. Gurdev Singh
Director of Horticulture
Navbahar, Shimla-2.

Subject: **Minutes of the meeting regarding promotion of Mycorrhiza fungus for plant growth held on 20th October, 2011.**

Sir,


Enclosed kindly find herewith the minutes of the meeting regarding promotion of Mycorrhiza fungus held on 20th October, 2011 under the Chairpersonship of Chief Secretary to the Govt. of Himachal Pradesh for information and necessary action please.


Director of Agriculture
Himachal Pradesh

Endst.No. As above,

Dated: Shimla-5, the

Copy forwarded to the Private Secretary to the Chief Secretary, Government of Himachal Pradesh, Shimla-2 for information and necessary action please.


Director of Agriculture
Himachal Pradesh

MINUTES OF MEETING HELD ON 20TH OCTOBER, 2011 AT 1.15 PM
UNDER THE CHAIRPERSONSHIP OF CHIEF SECRETARY TO THE
GOVERNMENT OF HIMACHAL PRADESH REGARDING PROMOTION
OF MYCORRHIZA FUNGUS FOR PLANT GROWTH.

The list of participants is enclosed as Annexure.

At the outset, Chief Secretary recalled the presentation given by Dr. K.S. Bains, Director General, Amity Institute before Hon'ble Chief Minister. Dr. Bains then explained about the performance in trials conducted in respect of Mycorrhiz (PFSI) at various places including HP. He said that effect of this fungus in crop growth and increased productivity is very good. He also submitted a copy of report given by the National Centre of Organic Farming, Government of India regarding the performance of this product and its use in the grain crops, Horticultural plants, sugarcane and vegetable etc. Dr. Bains wanted to know the administrative requirements of the State for further promotion of this product.

The Director of Agriculture explained that this fungus has not yet been included in the Fertilizer Control Order. Other Mycorrhiza which are obligate parasites have been included. He further explained that Mycorrhiza PFSI can be cultured only in the laboratory and no standards have yet been notified by Government of India for this fungus. Since this product is not covered under the provisions of FCO, therefore, there is no requirement of taking license for its distribution. The Director Agriculture explained to the committee the protocol for getting any product included in the FCO. He suggested that Institute may get this product tested through ICAR/SAUs and on the basis of performance reports and data generated, it can be included in the package of practices of the University and also in the FCO. The Chief Secretary directed the department that clarification be given to the Amity Institute. Dr. Bains informed that they have already appointed Lahaul Potato Growers Society as their promoters and will also appoint more such agencies.

Dr. Bains also said that there is great scope for improvement in Kuth and Manu herbs in Lahaul valley for which they would submit project proposals. Dr. Bains further informed that they are also trying the Microrrhiza(PFSI) fungus on willow tree which are facing problems and they would submit projects to the State Government. The Chairperson appreciated their initiative and advised them to submit proposals to the Principal Secretary (Auyrveda) and Addl. Chief Secretary (Forest) respectively.

The meeting ended with a vote of thanks to the Chairperson. ^{and from}

**DIRECTORATE OF AGRICULTURE
HIMACHAL PRADESH**

No.Agr.H(II-Tech)F(7)24/2006,

Dated: Shimla-5.th

2 NOV 2011

From

Director of Agriculture
Himachal Pradesh

To

✓ Dr. K.S.Bains
Director General
Amity Institute, Noida.

Subject: **Inclusion of fungus Mycorrhiza in Fertilizer Control Order- Reg.**

Sir,

Kindly refer to the discussions held in the meeting on 20th October, 2011 under the Chairpersonship of Chief Secretary to the Govt. of Himachal Pradesh.

During the meeting, it was made clear by the Director of Agriculture, Himachal Pradesh that the fungus Mycorrhiza (PFSI) has not been included in the Fertilizer Control Order however other Mycorrhiza being obligate parasites have been included in the Fertilizer Control Order recently. Since the fungus isolated by i.e Mycorrhiza (PFSI) is cultured in the laboratory and as yet no standards have been notified by Govt. of India therefore, your organization need not to obtain license under FCO for sale etc. in the State of Himachal Pradesh. It is for your information please.


Director of Agriculture
Himachal Pradesh

12AKV(LAS)

From

The Director of Agriculture, Punjab,
Chandigarh.

To

Dr. K.S. Bains,
Director General
Amity Institute, Noida.

Memo No.357/JDA (Inputs)
Chandigarh, dated: 30-03-2012

**SUBJECT: INCLUSION OF FUNGUS MYCORRHIZA IN FERTILIZER
CONTROL ORDER, 1985-REG.**

Kindly refer to the discussions held in the meeting on 24-02-2012
under the Chairmanship of Hon'ble Chief Minister, Punjab.

During the meeting, it was made clear by Director of Agriculture,
Punjab that the fungus Mycorrhiza (PFSI) has not been included in the Fertilizer
Control Order, 1985. However, other Mycorrhiza being obligate parasite has been
included in the FCO, 1985 recently. Since the fungus isolated i.e. Mycorrhiza
(PFSI) is cultured in the laboratory and as yet no standard have been notified by
the GoI, therefore, your organization need not to obtain any license under
FCO, 1985 in the State of Punjab. This is for your information please.

M. K. Bains 30/3/12
JDA (Inputs)
for Director Agriculture, Punjab.



Enclosure 5 *By hand*

भारत सरकार Government of India
कृषि मंत्रालय Ministry of Agriculture
कृषि और सहकारिता विभाग Department of Agriculture & Cooperation

राष्ट्रीय जैविक खेती केन्द्र

National Centre of Organic Farming

२०४-बी खण्ड, सी.जी.ओ. कॉम्प्लेक्स द्वितीय 204-B Wing CGO Complex-II
कमला नेहरू नगर, गाजियाबाद - 201 002 Karla Nehru Nagar, Ghaziabad-201 002

No. 10-9/2007-NCOF/ 8023

Date 18.10.2011

19

To
Dr Ajit Verma
Director General
AMITY Institute of Microbial Technology
Amity University, Noida, UP

Sub:- Regarding *Piriformospora indica* endophytic fungus for plant growth promotion.

Sir,

In reference to your letter No. AIMT/01/October 2011 Dated 14.10.2011, I have to clarify as follows:

1. The *Piriformospora indica* is a well known plant growth promoting endophyte with far extending hyphae.
2. Although its mechanism of action is very close to mycorrhiza, but being laboratory culturable, it is different from Mycorrhiza included in FCO and currently do not have defined quality standards.
3. Currently the said fungus is not included in FCO, therefore not subjected to any requirement of registration or licensing.
4. In my opinion the *Piriformospora indica* is a promising plant growth promoting fungus and need to be promoted for efficacy assessment on all crops. Based upon the literature available on its efficacy it is highly efficient in phosphorus and other micronutrient mobilization.
5. Besides nutrient mobilization the said fungus is also reported to harvest moisture for the plant from faraway niches not accessible to roots, thus helping plants to withstand draught and survive well at low moisture availability.
6. As it is not host specific and can infect all plants, it is an ideal choice for use in all crops, especially the grain crops, horticultural plants, sugarcane, vegetables etc.

I strongly recommend its promotion in all crops

Yours faithfully

(A.K. Yadav)
Director

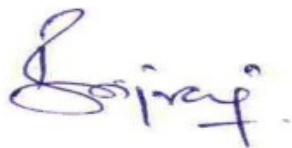
27 November 2012

Letter of Appreciation

Sunita Hydrocolloids Pvt. Ltd. in association with Dr. Amit C Kharkwal, Assistant Professor, Amity Institute of Microbial Technology, Amity University conducted a trial of beneficial fungus on guar crop in the month of July 2012 at dist. Hanumangarh, Rajasthan. Total area of sowing was one bigha for treated guar seeds with beneficial fungus and one bigha for control. It was observed that-

1. Germination in treated guar seeds was more in comparison to untreated one.
2. After few days of germination, plants with treatment were having larger, greener and shiny leaves.
3. Fruiting was earlier in treated plants; pods are longer in size.
4. Around 16% increment was observed in the yield of the guar crop which was treated with beneficial fungus.

We look forward to have association with Amity University for the next year sowing of guar and planning to conduct one commercial trial with beneficial fungus on guar crop in 100 bigha land.



Dr. B.R. Sharma,
Senior Manager-QARD



Technology Transfer Agreements of AIMIT, AUUP

S.No.	Technology	Date	Company
1	A Plant growth promoting formulation of <i>Piriformospora Indica</i> and <i>Azotobacter chroococcum</i> with talcum powder (Strains of <i>Piriformospora indica</i>)	17.08.2016	Sinon Inc, Taiwan
2	A Plant growth promoting formulation of <i>Piriformospora Indica</i> and <i>Azotobacter chroococcum</i> with talcum powder (Strains of <i>Piriformospora indica</i>)	08.12.2018	Sai Bio Organic, Moga, Punjab
3	A Plant growth promoting formulation of <i>Piriformospora Indica</i> and <i>Azotobacter chroococcum</i> with talcum powder (Strains of <i>Piriformospora indica</i>)	7.02.2020	SOM Phytopharma (India) Ltd, Hyderabad
4	A Plant growth promoting formulation of <i>Piriformospora Indica</i> and <i>Azotobacter chroococcum</i> with talcum powder (Strains of <i>Piriformospora indica</i>)	8.04.2021	Sri BioAesthetics Pvt Ltd, Hyderabad

जैवउर्वरक सूचना पत्र

BIOFERTILISER NEWSLETTER

अंक-२० Vol.- 20	क्र. ९ No.1	जून २०१२ June 2012
मुख्य संपादक Chief Editor डा. ए.के. यादव Dr. A.K. Yadav निदेशक Director राष्ट्रीय जैविक खेती केन्द्र, गाजियाबाद National Centre of Organic Farming Ghaziabad	<i>Piriformospora indica: The Model Microbe for Organic Green Revolution</i> Ajit Varma, Amit Kharkwal, K S Bains, Aparna Agarwal, Ruchika Bajaj and Ram Prasad	3
संपादक Editor रविन्द्र कुमार, Ravinder Kumar सहायक निदेशक/Assistant Director क्षेत्रीय जैविक खेती केन्द्र, बैंगलुरु RCOF, Bangaluru	Three New Biofertilizer Formulations Being Commercialised A.K. Yadav and K. Chandra	9
प्रकाशन सहायक Publication Assistant हरि भजन एवं सुभाष चंद्र Hari Bhajan & Subhash Chandra राष्ट्रीय जैविक खेती केन्द्र, गाजियाबाद NCOF, Ghaziabad	Research Notes	16
सलाहकार /Advisor डा कृष्ण चंद्र /Dr. Krishan Chandra अतिरिक्त आयुक्त /Additional Commissioner कृषि एवं सहकारिता विभाग, नई दिल्ली Department of Agriculture and Cooperation, New Delhi	Book Reviews	24
<p>Biofertilizer Newsletter (BFNL) is a bi-annual publication under National Project on Organic Farming, Ministry of Agriculture, Government of India. BFNL is registered with Indian Scientific Documentation Centre. Scientific articles, extension news, results of field trials, information about recent events and review of books are especially welcome. Regarding articles, opinion expressed in BFNL is that of the author(s) and should not be attributed to this Centre. Acceptance of manuscripts for publication in BFNL shall automatically mean transfer of copyright to Biofertilizer Newsletter.</p>		

Editorial

Dear Readers

Famous scientist Louis Pasteur had said that even the death will be incomplete without the presence of fungi. So is the importance of the fungi in human life. The Microorganisms have unbreakable linkage parallel to human life, with fungi even more prominent in viable-microbial processes associated with human. In agriculture also its importance is in tune with the thoughts of Louis Pasteur. It has an extended role in nutrient cycle and their availability to the plants. From solubilization to mobilization, absorption to transportation and itself being the source of nutrient, fungi has multifarious role in nutrition transmission between soil and plants. A number of mechanisms involving the role of fungi have been explained by scientists. Yet there are many ones to be explained to harvest its desired effect to meet the burgeoning requirements. A number of genus and species are still to be identified which certainly contribute in nutrient management but has no recognition. This issue in first paper reports new invention in mycorrhizal developments. Hope this pragmatic approach would help in efficient use of mycorrhizal cultures to obtain better yields and also would explore new dimensions in ongoing quests.

Certain microorganisms may become antagonistic to fellow microbes limiting their population in a given medium. Therefore assessment of the behavior of composite microbes in a given medium has remained an interesting subject. In this series the microorganisms of nutrient importance have a great scope of their mapping in various forms and conditions in both isolated and coexisting situations to obtain the target results. In the second paper of the issue authors have shown the way for effective use of microbes in combination. It is high time, the manufacturing sector adopt and promote such technologies so that their benefit can be reaped by the end users.

The permanent columns and features of the issue are accomplished with maximum latest inputs of relevant field. Hope the issue turns useful to its readers to their maximum satisfactions. We pay sincere thanks to authors of papers and valued readers for their continued interest attached with us.

*Ravinder Kumar
Editor and Assistant Director
RCOF, Bangaluru*

***Piriformospora indica*: The Model Microbe for Organic Green Revolution**

Ajit Varma^{1*}, Amit Kharkwal¹, K S Bains², Aparna Agarwal¹,
Ruchika Bajaj¹ and Ram Prasad¹

¹Amity Institute of Microbial Technology, Amity University Uttar Pradesh, Noida- 201303

²Amity Institute of Training and Development, Amity University Uttar Pradesh, Noida-201303

*Corresponding author E-mail: ajitvarma@aihmr.amity.edu

Introduction

The most complex area within the soil environment is the region of soil surrounding a plant root known as the “rhizosphere” or more appropriately “mycorrhizosphere”. The region differs from the surrounding soil in many physico-chemical factors and this soil along with the rhizoplane (i.e., the root surface) is colonized by a wide range of microorganisms representing the site with the highest microbial biomass and activity. It is here that interaction between plants and microorganisms are most intense, variable and mostly symbiotic. Nitrogen fixing root-nodule bacteria (*Rhizobium*), actinomycetes (*Frankia*) and mycorrhizal associations are some of the best studied examples of symbiosis.

The Background

Mycorrhiza refers to associations or symbioses between plants and fungi that colonizes the cortical tissue of roots during periods of active plant growth. Generally, these symbioses are often characterized by bi-directional exchange of plant-produced carbon (photosynthates) to the fungus and fungal-acquired nutrients to the plant thereby providing a critical linkage between the plant root and soil called arbuscules (Fig.1A, see inside of back cover, p-25). The term mycorrhiza (modern Latin of Greek words *mykes* + *fungi*, *rhiza* + *root*) which literally means “fungus-root” was first applied to fungus-tree associations described in 1885 by the German forest pathologist A.B. Frank (Fig. 1B see inside of back cover, p-25). About 90 per cent land plants, no matter where they grow are mycorrhized. The benefits accorded to the plants from

mycorrhizal symbioses can be characterized agronomically by increased growth, yield, providing regulation against biotic and abiotic stress and ecologically by improved fitness (i.e., reproductive ability).

Fig. 2 (inside of back cover, p-25) shows typical view of diverse mycorrhizal spores and they survive in the soil many years under adverse conditions. The key functions of AM symbiosis can be summarized as follows: (1) improving rooting and plant establishment, (2) enhancing plant tolerance to stresses, (3) improving nutrient cycling, and (4) enhancing plant community diversity. Besides, they are helpful in increased photosynthesis efficiency, increased water conducting capacity, enhanced nutrient uptake, enhanced plant tolerance to environmental stresses including drought, cold, salinity and pollution, providing protection from harmful soil borne pathogens, changing the supply of mineral nutrients from soil thereby modifying soil fertility, mycorrhizosphere and aggregation of soil particles and in promoting growth, fitness and conservation of endangered plants.

Despite numerous researches the fungus cannot be cultured in the laboratory condition in the absence of living root system. Arbuscular mycorrhizal fungi (AMF) are obligate symbionts and do not grow in the absence of living host. Despite the significant importance of the AMF to soil health and plant productivity, their biotechnological applications could not be exploited to the level they deserve due to this particular factor.

A Silver Lining in Mycorrhizal Research- Novel Discovery

Authors have discovered a new and novel cultivable mycorrhizal fungus and named it as *Piriformospora indica* (Fig 3 see inside of back cover, p-25). It is cultivable on synthetic media and is suitable for large scale multiplication and conversion into a commercial agro-biological product. Till date authors have found positive impact of the fungus on the diverse group of plants, including agriculture, horticulture, arboriculture, floriculture crops including medicinal plants. Experiments were performed in tissue culture laboratory, green house, under field trials in the cultivator fields in National Capital Region (NCR), Haryana, Himachal Pradesh and Uttarakhand.

Biotechnological Applications

Mutualistic interactions between microbes and agro-forestry, horticultural and medicinal plants have been attractive for many years, since mutualists can improve the growth, biomass and seed production on poor soil with little input of chemical fertilizers and pesticides. *P. indica* is strong candidates for supporting the mass scale production of cereals, medicinal plants and floriculture. They also combat virus and fungal pathogens.

Case Studies

I. Economic Importance

Sugar Cane: *P. indica*, increased the survival rate of micro-propagated sugarcane plantlets when inoculated at hardening stage (Fig. 4, see inside of back cover p-25). *P. indica* increased root and shoot dry weight of the plants by increasing water and nutrient uptake thereby making them healthier and hence increased their survival rate in the glasshouse and field. The increase in survival rates by 10% is of much significance and thus *P. indica* can be commercially exploited for bio-hardening of micro-propagated sugarcane plantlets to boost the sugarcane industry.

Sugarcane variety CoJ 83 and CoJ 88 were treated with *P. indica*. There was significant increase in tiller number (36%), cane number (51%), cane height (13%) and cane yield (10%) as compared to control. In the second crop (ratoon crop), iron deficiency was observed in the untreated plants. The treated plants also exhibited increased iron (39%) and copper (120%) acquisition (Table 1). Significantly higher tiller numbers (85%), cane numbers (96%), cane yield (13%) and sugar content (17%) was also observed (Table 2).

Table 1. Effect of *P. indica* on nutrient acquisition of sugarcane ratoon crop

Treatments	Fe (ppm)	Mn (ppm)	Cu (ppm)	Zn (ppm)	K (%)	P (%)
Control	202.2	25.0	4.9	1.87	0.24	0.086
<i>P. indica</i>	281.4	30.2	10.8	1.31	0.40	0.088
CD (5%)	47.07	NS	0.88	0.33	NS	NS

Table 2. Effect of *P. indica* inoculation on yield attributing characters and yield of sugarcane ratoon crop

Treatments	Tiller number/ clump	Cane number/ clump	Cane height (cm)	Cane girth (cm)	Sugar content*	Weight per clump (kg)	Weight per plot (kg)
Control	9.27	8.10	179	2.22	18.35	6.50	122.2
<i>P. indica</i>	17.2	15.90	191	2.21	21.40	7.34	138.3
CD (5%)	2.59	2.51	NS	NS	1.99	NS	2.39

*Brix Value

Zea mays: The experiments were conducted to study the role of *Piriformospora indica* in maize (*Zea mays* L) var PMH-1. The results suggest that inoculation of *P. indica* works efficiently especially in P-deficient soil and helps in P acquisition in P-deficient soils. It may be used as a potential biofertilizer in the areas where the soil is either phosphorus deficient or the areas where the practice of under application of phosphorus fertilizer is prevalent among the resource poor and marginal farmers.

P. indica Accelerates the Early Profuse Flowering in a large number of plants of economic importance. Typical examples in Tobacco, Brassica and the medicinal plant *Coleus* (see Fig. 5a, b and c):

***Piriformospora indica* a Boon for Pharmaceutical Industries**

Authors have found *P. indica*'s intense interaction with a large number of medicinal plants like *Bacopa monniera* (Brahmi), *Artemisia annua* (Sweet wormwood), *Azadirachta indica* (Neem), *Tridax procumbans* (Coat Buttons), *Abrus precatorius* (Rosary Pea), *Coleus forskohlii* (Makandi), *Ocimum sanctum* (Tulsi), *Stevia rebaudiana* (Sweet Leaf), *Chlorophytum borivilianum* (Safed Musli), *Withania somnifera* (Ashwagandha), *Spilanthes calva* and *Adhatoda vasica* increasing their biomass and their active ingredients. Table 3 gives the name of medicinal plant with which *P. indica* has positively interacted.

Table 3. Medicinal plants and its active ingredients

Medicinal Plants	Common name	Active Ingredients
<i>Bacopa monniera</i>	Brahmi	Bacosides
<i>Coleus forskohlii</i>	Makandi and Mayani	Forskolin
<i>Withania somnifera</i>	Ashwagandha, Indian ginseng	Tropine, cuscohygrine, withanolides
<i>Adhatoda vasica</i>	Malabar nut	Vasicine, vasicol
<i>Tridax procumbens</i>	Ghamra , Coat buttons and tridax daisy	
<i>Podophyllum hexandrum</i>	Himalayan May apple	picropodophyllin, podophyllotoxin, quercetin
<i>Spilanthes calva</i>	'toothache plant' or 'virus blocker'	spilanthol
<i>Abrus precatorius</i>	Wild Liquorice	abrin, abraline, choline, precatorine, abricin, abridin
<i>Chlorophytum borivilianum</i>	safed musli	saponins and alkaloids are the source of its aphrodisiac properties
<i>Ocimum sanctum</i>	Holy Basil	tannins, alkaloids and volatile oil (eugenol, ursolic acid, rosmarinic acid, thymol)
<i>Artemisia annua</i>	Sweet Wormwood, Sweet Annie	artemisinin
<i>Stevia rebaudiana</i>	Sweet Leaf, Sugar Leaf,	stevioside and rebaudioside
<i>Linum album</i>	White Flax	podophyllotoxin and 6-methoxypodophyllotoxin
<i>Trigonella foenum graecum</i>	Fenugreek	Saponins (diosgenin, yamogenin, gitogenin, tigogenin)
<i>Curcuma longa</i>	Turmeric	Curcumin
<i>Azadirachta indica</i>	Margosa Tree, Neem	nimbin, nimbinene, azadirachtin, azadirachtol, azadirachnol
<i>Foeniculum vulgare</i>	Fennel	Essential oil (a-pinene, myrcene, fenchone, limonene)
<i>Solanum nigrum</i>	Black Night Shade, Makoy	solanine

Some case studies on medicinal plants

Bacopa monniera: *Bacopa* a well-known memory booster is a classic brain and nervine tonic known as "Brahmi" in Ayurveda that benefits both the mind and improve the intellect and consciousness. The interaction of the fungus *P. indica* with *Bacopa* plant resulted in an unprecedented increase in the plant biomass, photosynthetic pigments, metabolic regulators and active ingredients like antioxidant and bacosides many fold (unpublished data).

Artemisia annua: Artemisinin (an anti-malaria drug) has shown very strong potential as a non-conventional antimalarial drug and recommended by WHO in combination therapies as one of the ingredients for the treatment of drug resistant and cerebral malaria. Several attempts have been made for the selection and breeding of high-yielding strains of *A. annua* plant resulting in significantly increased production of artemisinin (1.1%), but still far behind to meet the demands of market. Hence, to increase artemisinin content in *Artemisia annua* plant the most feasible alternative for the commercial production of this compound is to facilitate interaction of live cells of *Artemisia annua* with symbiotic fungus *P. indica*.

Spilanthes calva: *Spilanthes calva*, commonly known as toothache plant or virus blocker, is well known for enhancing immunity. Because of its high medicinal value, it is costly and there is much demand of this plant in the market. This plant has antiageing properties and cures various diseases of tooth and gums including pyorrhoea. It is antimicrobial in nature and economically very useful as tooth powder, which is prepared from this plant. Its leaves stimulate salivation, which is due to the presence of an active chemical spilanthol. The influence of *P. indica* on the antifungal principle of *S. calva*, was studied. Antifungal efficacy was shown by aqueous and petroleum ether extracts of *S. calva* against

Fusarium oxysporum and *Trichophyton mentagrophytes*. The petroleum ether extract of *S. calva* was more effective than the aqueous extract in inoculated as well as uninoculated plants. The antifungal activity of the plant was enhanced due to the increase in spilanthol content after inoculation of *P. indica*.

Safed musli: Scientifically known as *Chlorophytum borivillianum*, is endowed with Rasayana (antiageing and immunoboosting), Balya (performance-boosting) and Vrishya (aphrodisiac) properties to keep one young and healthy with a well-tuned body for better handling of stress. Phytochemicals like saponins, carbohydrate and proteins are present in the root. They are normally used to maintain the equilibrium of all the systems of the body and keep the "Body-Mind-Soul Complex" in a state of harmony. Biotization of *Chlorophytum borivillianum* with *P. indica* and *Pseudomonas fluorescens* increased resistance of plants to biotic and abiotic stresses at the time of transplantation thus protect them from 'transplantation shock'.

Culture filtrate of P. indica Promotes Growth

The culture filtrate of this fungus has been treated with various seeds like Bengal gram, rajma, wheat, mustard etc. It has been shown this fungus is capable of enhancing early seed germination, plant growth and yield like biomass.

Authors have conducted large scale field trials in vegetable crops, cereals, sugarcane, horticultural plants etc. in states of Punjab, Himachal Pradesh and Delhi NCR. In general 10-40% increase in plant productivity was observed with concomitant reduction of pesticide usage in the treated plants (Table 4).

P. indica is considered a magic fungus which promotes plant productivity at various agro climatic conditions. At the same time it obviates the pathogenesis.

Table 4. Performance of *Piriformospora indica* Trial on Vegetables and other Crop plants in Punjab.

Crop	Place	Yield in Q/ha		% change	Remarks
Cotton	Muktsar	6	7.2	20.00	The treated plants were healthier and were less affected by insects and pests as observed by farmer. The results were authenticated by Dr. Jalore Singh, ADO, Lambi
Maize	SAS Nagar	24	28	16.67	On an average a yield of 14.64 % is reported after application of <i>P. indica</i> .
Maize	SAS Nagar	23	26	13.04	Results Authenticated by Dr. Rajesh Kumar, ADO
Maize	SAS Nagar	24	27	12.50	Results Authenticated by Dr. Rajesh Kumar, ADO
Maize	SAS Nagar	22	25	13.64	Results Authenticated by Dr. Rajesh Kumar, ADO
Maize	SAS Nagar	23	27	17.39	Results Authenticated by Dr. Rajesh Kumar, ADO
Wheat	Amritsar	14	14.5	3.57	Results Authenticated CAO
Wheat	Bathinda	18.72	19.04	1.71	Results Authenticated CAO
Wheat	Faridkot	19.04	19.68	3.36	Results Authenticated CAO
Wheat	Fatehgarhsahib	18.66	19.52	4.61	Results Authenticated CAO
Wheat	Ferozpur	18.25	18.65	2.19	Results Authenticated CAO
Wheat	Hoshiarpur	19.8	20.8	5.05	Results Authenticated CAO
Wheat	Jalandhar	17.93	18.2	1.51	Results Authenticated CAO
Wheat	Mansa	17.6	18	2.27	Results Authenticated CAO
Wheat	Sangrur	18.61	20.24	8.76	Results Authenticated CAO
Wheat	Tarn Taran	17.01	17.32	1.82	Results Authenticated CAO
Wheat	Muktsar	18.5	19.51	5.46	Results Authenticated CAO
Tomato	Kapurthala	225	250	11.11	Growth Better in Treated, Pesticide Spray kept constant
Tomato	Kapurthala	210	230	9.52	Stem borer and whitefly infestation less in treated; Pesticide (Midda and Coragen) usage reduced by 50 % in treated
Egg Plant	Kapurthala	50	100	100.00	Stem borer and whitefly infestation 50 % less in treated; Pesticide (Midda and Coragen) usage reduced by 50 % in treated; Fruit quality good in treated with no white spot
Muskmelon	Jalandhar	70	90	28.57	Results Authenticated by Horticulture Assistant
Bottle Gourd	SBS Nagar	150	200	33.33	Results Authenticated by HDO
Bottle Gourd	Kartarpur, Amritsar	80	100	25.00	Blight and Aphd attack in control; Pesticide spray M-45, Metalex reduced by 50% in treated; Treated fruit more sweet in taste
Pumpkin	Kartarpur, Amritsar	70	80	14.29	White fly infestation less in treated; Pesticide (M-45) weekly spray in treated and every four day in control
Onion	Kartarpur Amritsar	5	6.	20.00	Only for seed production

Acknowledgement

Authors are thankful to Dr A K Yadav, Director NCOF, Ghaziabad, Uttar Pradesh for encouraging us to write this article.

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Burkholderia a New biofertiliser for Improvement in Cereal Productivity

Biofertilizers are rhizosphere microorganisms inoculated to reduce the need for N or P fertilizer application and maximize plant growth and nutrition, resulting in greater grain yield and N or P content. A study was carried out to evaluate the effectiveness of diazotrophic bacteria isolated from the rhizosphere of wheat in Victoria, Australia and results are presented in the form of a thesis. This thesis shows that N₂ fixing Burkholderia species have great potential as biofertilizers on wheat productivity. The thesis is divided into 5 chapters with first chapter being introduction.

In Chapter 2, strains of bacteria were isolated from wheat-growing soils in main Victoria wheat belt at Horsham and Birchip in North West Victoria. Strains were identified as Burkholderia spp. by their closest matches in the 16S DNA and by morphology and physiology.

In Chapter 3, one selected strain from each of Birchip and Horsham were used to inoculate wheat in a pot trial in a glasshouse during winter-spring. Soil was collected on site from wheat fields. Pots were inoculated with these strains to evaluate the effects of Burkholderia inoculum as Biofertilizer on the plant growth and yield. Different nitrogen sources (urea 46% N and ammonium sulphate 21% N) were used as fertilizer at one of four levels (0, 50, 100 and 150 kg N/ ha).

In Chapter 4, field-grown wheat was inoculated with the same strains of Burkholderia. Three experiments were carried out in plots at two sites, dry land and irrigated fields at Horsham and a dry land field at Birchip, during the winter wheat season of 2006, to evaluate the effect of Burkholderia species inoculum and different types of nitrogen source at one of four levels of added N (0, 50, 100 and 150 kg N/ha) on wheat growth and yield. The effects of both bacterial inoculation and N fertiliser on growth promotion and grain yield were observed. Grain %N as well as total N content in grain per area in the Horsham irrigated field increased with increasing N fertiliser levels up to 100 kg N/ha.

In Chapter 5, acetylene reduction (ARA) activity was measured in the pots for both inoculated and un-inoculated plants at various growth stages and populations of nitrogen-fixing bacteria associated with the wheat roots and bulk soil were measured in addition to biomass and N content of plants and grain. Molecular tracing using specific primers showed that the inoculum was present only in inoculated treatments. Up to 60% of the increased N content of the grain in inoculated plants was potentially derived from nitrogen fixed by the inoculum in the rhizosphere.

It was concluded that the most significant result due to inoculation was the consistent maximal increase of N content in grain in inoculated treatments with ammonium sulphate fertilizer at 100 kg N/ha. Inoculation with Burkholderia consistently increased %N in wheat grain, with the potential benefit of decreasing the production cost and reducing use of chemical fertilizers.

(Source - Ben Mahmud, M 2008, *Effect of Burkholderia as biofertiliser on cereal productivity*, PhD Thesis, School of Applied Sciences, RMIT University)

Scientists discover fungus to boost crop yield

TRIBUNE NEWS SERVICE

SHIMLA, JANUARY 29

A cultivable mycorrhiza-like fungus discovered by scientists of Amity University may prove to be a boon for vegetable growers of Himachal Pradesh as it has tremendously increased the crop growth and productivity.

The scientists found that the fungus named *Piriformospora indica* (PFSI) increased both the growth and productivity of cauli-

flower, capsicum and tomato vegetable crops in hill areas of the state.

Director General, Amity Institute of Training and Development (AITD) KS Bains said the National Centre of Organic Farming, an institution under the Union Ministry of Agriculture, had recommended the use of the fungus in all crops, especially in horticulture plants, grain crops and vegetables, as an ideal choice.

He said a team of scientists conducted successful

trials on vegetable crops in Kangra and Kullu districts in varied temperatures. About 125 farmers were provided free samples of the fungus for use on crops in about 150-kanal area. He added that field trials in both these places had been successful and the crop yield, quality and productivity had increased manifold due to the use of this fungus. It also improved the growth and overall biomass production of diverse hosts, including legumes, medicinal and eco-

nomically important plants.

Bains said Amity would also provide free samples of the fungus to apple orchardists in Himachal Pradesh for protecting from various diseases and improving the productivity and quality of the apple crop. The institute had appointed the Lahaul Potato Society, Manali, as its nodal agency for the promotion of the fungus in the farming community and it was in the process to appoint more such agencies in the state.

*May send
all those to An Ajit Kumar
Return request
KSLs
10/2*

Fungal bio-fertiliser, hope for blight-hit potato farmers

KULDEEP CHAUHAN
TRIBUNE NEWS SERVICE

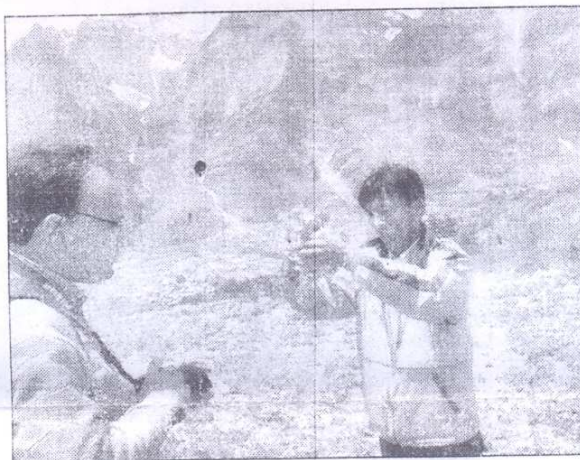
KEYLONG (LAHAUL-SPITI),
JUNE 25

Buoyed by its initial positive results on pea crop here, more than 220 farmers in this landlocked tribal belt have come forward undertaking field trials on a fungal bio-fertiliser - Piriformospora indica (PFSI)- introduced here for the first time by scientists from Amity's Microbial Technology Institute, Noida, in its bid to bail out farmers from the present crisis in productivity.

The farmers here are upbeat as the discovery of this fungal bio-fertiliser came at a time when the blight-hit disease-free seed potato that dipped its production from 12,500 metric tonne (MT) in 2009 to just 9,500 MT as temperatures soared to over 28 degree Celsius, the highest recorded in the valley last year.

After getting a go-ahead from Chief Minister PK Dhumal, Amity's team led by KS Bains, Director-General, Amity, and Dr Amit C Kharkwal, a microbial technologist, conducted here four camps with the Lahaul Potato Society (LPS) at Keylong, Kolong, Jahalma and Sissus and visited some fields to verify PFSI's initial results on crops here from June 17-19.

Ranvir, a farmer at Sumnam village, says, "I applied PFSI on peas. It germinated earlier



A scientist from Amity microbial technology, Dr Amit, examines the effect of bio-fertiliser on peas at a Suman village field. Photo by writer

Amity scientists claim

- PFSI is isolated from Mycorrhiza, a bio-fertiliser
- This fungus works in 45°C to -18°C and promotes early growth and flowering and shows better results on seeds and seedlings.
- Resistant to diseases and insects, wild rats and extreme weather
- One gm of PFSI contains 1 million spores that utilise nutrients from soil and replenishes soil with nitrogen using old roots in soil

and growth of plant is also better now. Nitrogen fixing is greater in the fungus-treated plants here and plants have a greater number of modules as compared with the controlled plants", observes Dr Amit at Sumnam.

But Sherab Ram, a farmer from Kardang village, says he has yet to see better results from the PFSI-treated plants.

Both types are growing with same size so far, he adds.

Norbu Barongpa, former chairman, LPS, says that the PFSI bio-fertiliser is the need of the hour as productivity has dipped and it has shown good results on crops here. "Every bag of potato used to produce 20 bags in the 1980s and today it has come down to half throwing

farmers in a crisis".

Bains, known by Lahaul farmers as "Alu Wala DC" as he helped in commercialising potato and formed the LPS in 1965-66 when he was DC here, says they chose Lahaul for field trials because farmers are hardworking and open to innovation.

He says the Amity conducted 35 field trials in different parts of Punjab, Rajasthan, Leh, Central India and found that PFSI gave about 10-20 per cent increase in productivity of sugarcane, vegetables and medicinal plants. "Even the size, shine and quality of fungus-treated crops are better and farmers get better returns", he claims.

Dr Amit says the excessive use of chemical fertilisers, pesticides and insecticides has eradicated natural fungus from roots in the soil. "We isolated PFSI Rajasthan in 1990. It works better in adverse conditions, is tolerant to extreme heat or chill and protects crops from insect-diseases. Farmers can apply using any current agricultural practice", he adds.

Chairman, LPS, Chhetan Azad, says more than 200 farmers will try this in the field and if results are positive, the society will provide this bio-fertiliser to its members at reasonable rates. "We will tie up with the Amity as we have seen positive results on crops in Lahaul", adds Dogra, MD, LPS.

वैज्ञानिकों ने की पहाड़ी क्षेत्रों के लिए नई फंगस की खोज

Pooja Kaur

शिमला, 29 जनवरी (ब्यूरो) : एमिटी विश्वविद्यालय-नोएडा (उत्तर प्रदेश) के वैज्ञानिकों ने एक ऐसी नई फंगस की खोज की है जोकि हिमाचल प्रदेश के पहाड़ी क्षेत्रों में फूल गोभी, शिमला मिर्च तथा टमाटर जैसी फसलों के विकास तथा पैदावार को बढ़ाने में जबरदस्त मददगार साबित होगी। भारत सरकार के कृषि मंत्रालय के संस्थान राष्ट्रीय जैविक खेती केंद्र ने इस फंगस के प्रयोग को फसलों में प्रयोग के लिए मंजूरी प्रदान कर दी है।

विश्वविद्यालय के महानिदेशक के.एस. वैंस ने बताया कि एमिटी इंस्टीच्यूट ऑफ माइक्रोबाइल टेक्नोलॉजी के वैज्ञानिकों द्वारा किए गए शोध से विकसित इस फंगस को पिरिफोरमोसपोरा इंडिका नाम दिया गया है तथा इस फंगस का राज्य के कांगड़ा तथा कुल्लू जिला के 125 किसान लगभग 150 कनाल भूमि पर फसलों की पैदावार तथा गुणवत्ता बढ़ाने का सफल परीक्षण

कर चुके हैं। उन्होंने कहा कि इन दोनों जिलों में इस फंगस के प्रयोग से फसलों को हानिकारक जीवाणुओं से बचाने में मदद मिली है जिससे किसानों की कीटनाशकों आदि पर निर्भरता भी कम हुई है। उन्होंने बताया कि इस फंगस को फलीदार औषधीय तथा आर्थिक दृष्टि से महत्वपूर्ण पौधों पर प्रयोग किया गया जिससे इन पौधों की बायोमास उत्पादन वृद्धि में उत्साहजनक परिणाम सामने आए हैं। उन्होंने बताया कि एमिटी विश्वविद्यालय राज्य में सब की फसल को रोगों से बचाने तथा फसल की पैदावार तथा गुणवत्ता में बढ़ोतरी के लिए सब उत्पादक क्षेत्रों में इसे प्रारंभिक तौर पर बागवानों को मुफ्त प्रदान करेगा। उन्होंने बताया कि एमिटी विश्वविद्यालय ने लाहौल पोटेडो सोसायटी मनाली को इसके वितरण के लिए मोडल एजेंसी तैनात किया है तथा निकट भविष्य में अतिरिक्त 'सियों' को भी नियुक्त जाएगा।

Toi.

New fungus trials on crops successful, say experts:

Scientists have conducted successful trials on vegetable crops in varied temperatures of Himachal Pradesh with the use of a newly identified fungus. A team conducted trials in Kangra and Kullu districts, where around 125 farmers were provided free samples of the fungus, *Piriformospora indica* (PFSI), for use in around 150 kanal area of crops. Scientists claim that field trials at both these places have been successful and the crop yield, quality and productivity have increased after the use of this fungus. K S Bajns, director general, Amity Institute of Training and Development (AITD), said the Union ministry's national centre of organic farming has recommended the use of fungus in all crops as an ideal choice. He said the university will provide free samples of the fungus to apple growers in the state.

Fungus trials successful on vegetable crops

DP CORRESPONDENT

Shimla

Trials on vegetable crops in varied temperatures of Himachal Pradesh have been successful with the use of a newly identified fungus.

"Field trials on cauliflower, capsicum and tomato crops in Kangra and Kullu districts have been successful with the use of cultivable mycorrhiza-like fungus *Piriformospora indica*", Amity Institute of Training and Development director general K. S. Bains said in a statement here. He said more than 125 farmers were provided free samples of the fungus for use in crops cultivated on 150

kanal land. "The trials on both these places have been successful and the crop yield, quality and productivity has increased manifold due to the fungus," he said.

The institute said the National Centre of Organic Farming, a wing of the Ministry of Agriculture, has recommended the use of this fungus in all crops, especially in horticulture, grain and vegetables. Bains said the scientists of Amity at its campus in Noida in Uttar Pradesh have discovered the fungus. He said the institute would provide free samples of the fungus to the apple growers in the hills state to increase content and quality of the crop.

Daily Post
Chandigarh

एमिटी विश्वविद्यालय नोएडा के वैज्ञानिकों ने पहाड़ी क्षेत्रों के लिए की खोज

‘फंगस’ से बड़ेगी हिमाचल प्रदेश में फसलों की पैदावार

● अमर उजाला ब्यूरो

शिमला। हिमाचल प्रदेश में फूल गोभी, शिमला मिर्च, टमाटर की पैदावार बढ़ाने में ‘फंगस’ मदद करेगी। एमिटी विश्वविद्यालय नोएडा (उत्तर प्रदेश) के वैज्ञानिकों ने एक ऐसी नई फंगस की खोज की है जोकि हिमाचल प्रदेश के पहाड़ी क्षेत्रों में इस फसलों के विकास तथा पैदावार को बढ़ाने में जबरदस्त मददगार साबित होगी। केंद्र सरकार के कृषि मंत्रालय के संस्थान राष्ट्रीय जैविक खेती केंद्र ने इस फंगस के प्रयोग को फसलों में प्रयोग के लिए मंजूरी प्रदान कर दी है। यह जानकारी प्रेस संपर्क कार्यालय के प्रवक्ता ने दी।

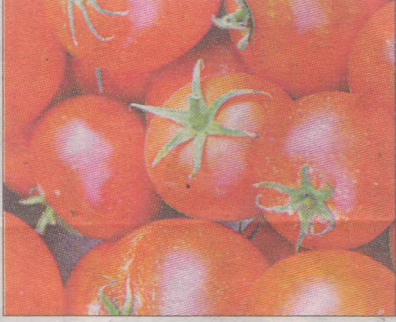
विश्वविद्यालय के महानिदेशक

केएस बैस ने बताया कि एमिटी इंस्टीट्यूट आफ माइक्रोबाईल टेक्नोलॉजी के वैज्ञानिकों के शोध से विकसित इस फंगस को पिरिफोरमोसपोरा इंडिका का नाम दिया गया है तथा इस फंगस का राज्य के कांगड़ा तथा कुल्लू जिलों के 125 किसान लगभग 150 कनाल भूमि पर फसल की पैदावार तथा गुणवत्ता बढ़ाने का सफल परीक्षण कर चुके हैं। उन्होंने कहा कि इन दोनों जिलों में इस फंगस के प्रयोग से फसलों को हानिकारक जीवाणुओं से बचाने में मदद मिली है, जिससे किसानों की कीटनाशकों आदि पर निर्भरता भी कम हुई है। उन्होंने बताया कि इस फंगस को फलीदार, औषधीय तथा आर्थिक दृष्टि से महत्वपूर्ण पौधों पर

● फंगस का

फलीदार, औषधीय तथा आर्थिक दृष्टि से महत्वपूर्ण पौधों पर किया प्रयोग

● फूल गोभी, शिमला मिर्च, टमाटर की फसलों को लाभ कांगड़ा व कुल्लू जिलों के किसान कर चुके हैं प्रयोग



कृषि मंत्रालय के संस्थान राष्ट्रीय जैविक खेती केंद्र ने इस फंगस के प्रयोग को फसलों में प्रयोग के लिए मंजूरी प्रदान कर दी है। वैज्ञानिकों के शोध से विकसित इस फंगस को पिरिफोरमोसपोरा इंडिका का नाम दिया गया है। फंगस के प्रयोग से फसलों को हानिकारक जीवाणुओं से बचाने में मदद मिली है, जिससे किसानों की कीटनाशकों आदि पर निर्भरता भी कम हुई है।

प्रयोग किया गया, जिससे इन पौधों के लिए नोडल एजेंसी तैनात किया है तथा निकट भविष्य में अन्य एजेंसियों को भी नियुक्त किया जाएगा। उन्होंने बताया कि फलीदार, औषधीय तथा आर्थिक दृष्टि से महत्वपूर्ण पौधों पर

की पैदावार तथा गुणवत्ता में बढ़ोतरी के लिए सेब उत्पादक क्षेत्रों में इसे प्रारंभिक तौर पर बागवानों को मुफ्त

प्रदान करेगा। उन्होंने बताया कि वैज्ञानिकों ने लाहौर पोर्टो सोसायटी, मनली को इसके वितरण

आपका फैसला

एमिटी विवि के वैज्ञानिकों ने की नई फंगस की खोज

एजेंसियां

नई दिल्ली, 29 जनवरी। एमिटी विश्वविद्यालय नोएडा उत्तर प्रदेश के वैज्ञानिकों ने एक ऐसी 'फंगस' की खोज की है, जोकि हिमाचल प्रदेश के पहाड़ी क्षेत्रों में फूल गोभी, शिमला मिर्च तथा टमाटर जैसी फसलों के विकास तथा पैदावार को बढ़ाने में जबरदस्त मददगार साबित होगी। भारत सरकार के कृषि मंत्रालय के संस्थान राष्ट्रीय जैविक खेती केंद्र ने इस 'फंगस' के प्रयोग को फसलों में प्रयोग के लिए मंजूरी प्रदान कर दी है। विश्वविद्यालय के महानिदेशक केएस वेंस ने बताया कि एमिटी इंस्टीच्यूट आफ माईक्रोबाइल टेक्नोलॉजी के वैज्ञानिकों द्वारा किए गए शोध से विकसित इस 'फंगस' को पिरिफोरमोसपोरा इंडिका का नाम दिया गया है तथा इस 'फंगस' का

राज्य के कांगड़ा तथा कुल्लू जिला के 125 किसान लगभग 150 कनाल भूमि पर फसल की पैदावार तथा गुणवत्ता बढ़ाने का सफल परीक्षण कर चुके हैं। उन्होंने कहा कि इन दोनों जिलों में इस 'फंगस' के प्रयोग से फसलों को हानिकारक जीवाणुओं से बचाने में मदद मिली है, जिससे किसानों की कीटनाशकों आदि पर निर्भरता भी कम हुई है। उन्होंने बताया कि इस 'फंगस' को फलीदार, औषधीय तथा आर्थिक दृष्टि से महत्वपूर्ण पौधों पर प्रयोग किया गया, जिससे इन पौधों के बायोमास उत्पादन वृद्धि में उत्साहजनक परिणाम सामने आए हैं। एमिटी विवि राज्य में सेब की फसल को रोगों से बचाने तथा फसल की पैदावार तथा गुणवत्ता में बढ़ोतरी के लिए सेब उत्पादक क्षेत्रों में इसे प्रारंभिक तौर पर बागवानों को मुफ्त प्रदान करेगी।

Aap Ka Faisla

Shinde

वैज्ञानिकों ने की पहाड़ी क्षेत्रों के लिए नई फंगस की खोज

शिमला, 29 जनवरी (ब्यूरो): एमिटी विश्वविद्यालय नोएडा (उत्तर प्रदेश) के वैज्ञानिकों ने एक ऐसी नई फंगस की खोज की है जोकि हिमाचल प्रदेश के पहाड़ी क्षेत्रों में फूल गोभी, शिमला मिर्च तथा टमाटर जैसी फसलों के विकास तथा पैदावार को बढ़ाने में जबरदस्त मददगार साबित होगी। भारत सरकार के कृषि मंत्रालय के संस्थान राष्ट्रीय जैविक खेती केन्द्र ने इस फंगस के प्रयोग को फसलों में प्रयोग के लिए मंजूरी प्रदान कर दी है।

विश्वविद्यालय के महानिदेशक के.एस. वैनस ने बताया कि एमिटी इंस्टीच्यूट ऑफ माइक्रोबाइल टेक्नोलॉजी के वैज्ञानिकों द्वारा किए गए शोध से विकसित इस फंगस को पिरिफोरमोसपोरा इंडिका नाम दिया गया है तथा इस फंगस का राज्य के कांगड़ा तथा कुल्लू जिला के 125 किसान लगभग 150 कनाल भूमि पर फसल की पैदावार तथा गुणवत्ता बढ़ाने का सफल परीक्षण

कर चुके हैं। उन्होंने कहा कि इन दोनों जिलों में इस फंगस के प्रयोग से फसलों को हानिकारक जीवाणुओं से बचाने में मदद मिली है जिससे किसानों की कीटनाशकों आदि पर निर्भरता भी कम हुई है। उन्होंने बताया कि इस फंगस को फलीदार, औषधीय तथा आर्थिक दृष्टि से महत्वपूर्ण पौधों पर प्रयोग किया गया जिससे इन पौधों की बायोमास उत्पादन वृद्धि में उत्साहजनक परिणाम सामने आए हैं। उन्होंने बताया कि एमिटी विश्वविद्यालय राज्य में सेब की फसल को रोगों से बचाने तथा फसल की पैदावार तथा गुणवत्ता में बढ़ोतरी के लिए सेब उत्पादक क्षेत्रों में इसे प्रारंभिक तौर पर बागवानों को मुफ्त प्रदान करेगा। उन्होंने बताया कि एमिटी विश्वविद्यालय ने लाहौल पोटेटो सोसायटी मनाली को इसके वितरण के लिए नोडल एजेंसी तैनात किया है तथा निकट भविष्य में अतिरिक्त एजेंसियों को भी नियुक्त किया जाएगा।

एमटी विश्वविद्यालय नोएडा के वैज्ञानिकों द्वारा पहाड़ी क्षेत्रों के लिए नई खोज

जालामुखी, 29 जनवरी (बिजेन्द्र शर्मा): एमटी विश्वविद्यालय नोएडा उत्तर प्रदेश के वैज्ञानिकों ने एक ऐसी नई फंगस की खोज की है जोकि हिमाचल प्रदेश के पहाड़ी क्षेत्रों में फूल गोभी, शिमला मिर्च तथा टमाटर जैसी फसलों के विकास तथा पैदावार को बढ़ाने में जबरदस्त मददगार साबित होगी। भारत सरकार के कृषि मंत्रालय के संस्थान राष्ट्रीय जैविक खेती केन्द्र ने इस फंगस के प्रयोग को फसलों में प्रयोग के लिए मंजूरी प्रदान कर दी है। विश्वविद्यालय के महानिदेशक के. एस. वेन्स ने बताया कि एमटी इन्स्टीच्यूट ऑफ माईक्रोबाईल टैक्नोलोजी के वैज्ञानिकों द्वारा किए गए शोध से विकसित इस फंगस को पिरिफोरमोसपोरा इंडिका का नाम दिया गया है तथा इस फंगस का राज्य के कांगड़ा तथा कुल्लू जिला के 125 किसान लगभग 150 कनाल भूमि पर फसल की पैदावार तथा गुणवत्ता बढ़ाने का सफल

परीक्षण कर चुके हैं। उन्होंने कहा कि इन दोनों जिलों में इस फंगस के प्रयोग से फसलों को हानिकारक जीवाणुओं से बचाने में मदद मिली है जिससे किसानों की कीटनाशकों आदि पर निर्भरता भी कम हुई है।

उन्होंने बताया कि इस फंगस को फलीदार, औषधीय तथा आर्थिक दृष्टि से महत्वपूर्ण पौधों पर प्रयोग किया गया जिससे इन पौधों के बायोमास उत्पादन वृद्धि में उत्साहजनक परिणाम तथा फसल की पैदावार तथा गुणवत्ता में बढ़ोत्तरी के लिए सेब उत्पादक क्षेत्रों में इसे प्रारम्भिक तौर पर बागवानों को मुफ्त प्रदान करेगी। उन्होंने बताया कि एमटी विश्वविद्यालय ने लाहौर पोटाटो सोसायटी मनाली को इसके वितरण के लिए नोडल एजेंसी तैनात किया है तथा निकट भविष्य में अतिरिक्त एजेंसियों को भी नियुक्त किया जाएगा।

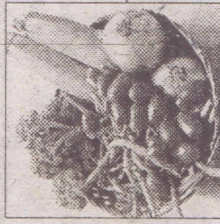
फंफास बढ़ाएगी

एमिटी विश्वविद्यालय की खोज से
फिरेने हिमाचली किसानों के दिन

दिव्य हिमाचल ब्यूरो, नई दिल्ली

एमिटी विश्वविद्यालय नोएडा, उत्तर प्रदेश के वैज्ञानिकों ने एक ऐसी नई फंफस की खोज की है, जो कि हिमाचल के पहाड़ी क्षेत्रों में फूलगोभी, शिमला मिर्च तथा टमाटर जैसी फसलों के विकास तथा पैदावार को बढ़ाने में मददगार साबित होगी। भारत सरकार के कृषि मंत्रालय के संस्थान राष्ट्रीय जैविक खेती केंद्र ने इस फंफस के फसलों में प्रयोग के लिए मंजूरी प्रदान कर दी है। विश्वविद्यालय के महानिदेशक केएस बैस ने बताया कि

से फसलों को हानिकारक जीवाणुओं से बचाने में मदद मिली है। इससे किसानों की कीटनाशकों आदि पर निर्भरता भी कम हुई है। उन्होंने बताया कि फंफस का फलीदार, औषधीय तथा आर्थिक दृष्टि से महत्वपूर्ण पौधों पर प्रयोग किया गया, जिससे इन पौधों के बायोमास उत्पादन वृद्धि में उत्साहजनक परिणाम सामने आए हैं। उन्होंने बताया कि एमिटी विश्वविद्यालय हिमाचल में सेब की फसल को रोगों से बचाने, फसल की पैदावार तथा गुणवत्ता में बढ़ोतरी के लिए सेब उत्पादक क्षेत्रों में इसे प्रारंभिक तौर पर बागबानों को मुफ्त



फसल को रोगों से बचाने, फसल की पैदावार तथा गुणवत्ता में बढ़ोतरी के लिए सेब उत्पादक क्षेत्रों में इसे प्रारंभिक तौर पर बागबानों को मुफ्त

फसलों की पैदावार बढ़ाने में फिरीफोरमोसपोरा इंडिका रामबाण

कांगड़ा-कुल्लू जिला में सफल परीक्षण सेब उत्पादक क्षेत्रों में मुफ्त बांटी जाएगी दवाई

प्रदान करेगी। उन्होंने बताया कि एमिटी विश्वविद्यालय ने लाहुली पोर्टेडो सोसायटी मनाली को इसके वितरण के लिए नोडल एजेंसी तैनात किया है तथा निकट भविष्य में अतिरिक्त एजेंसियों को भी नियुक्त किया जाएगा।

साखियायों की पैदावार

1500 हेक्टेयर में उगे सेब के बागीचे
रुफ सिपोर्ट, शिमला

राज्य बागबानी विभाग ने इस साल 1500 हेक्टेयर भूमि में सेब के नए बागीचे लगाने का लक्ष्य निर्धारित किया है। बागबानों की सेब के नए प्लांट की जरूरतों को पूरा करने के लिए विभाग 583 पंजीकृत निजी व सरकारी नर्सरियों में सेब के प्लांट तैयार कर रहा है। प्रदेश सरकार की एम्पलरी-प्लांटेशन योजना से आगामी पांच वर्षों के दौरान 5000 हेक्टेयर क्षेत्र पर सेब के नए बागीचे तैयार किए जाएंगे। एम्पलरी-प्लांटेशन योजना पर 85 करोड़ रुपये व्यय किए जाएंगे। बागबानी विभाग की योजना के



मुहैया कराए जा रहे हैं। बागबानी विभाग के निदेशक डा. गुरदत्त सिंह ने बताया कि बागबानों को उन्नत किस्मों के प्लांट दिए जा रहे हैं।

मुताबिक सेब के पुराने व कम उत्पादन वाले पौधों को उखाड़कर नई व उन्नत किस्मों के बागीचे तैयार किए जाएंगे, ताकि उत्पादन के साथ-साथ आर्थिकी में सुधार किया जा सके। इस बार अच्छी बारिश व बर्फबारी के बाद प्रदेश के अधिकतर क्षेत्रों में बागबान सेब के प्लांट की अधिक मांग कर रहे हैं। बागबानी विभाग दावा कर रहा है कि बागबानों की जरूरत को पूरा करने के लिए निजी व सरकारी नर्सरियों में विभिन्न किस्मों के 45 हजार से अधिक प्लांट तैयार किए जा रहे हैं।

यानी कम ऊंचाई वाले क्षेत्रों में कम चिलिंग आवर्ज की जरूरत वाले प्लांट दिए जा रहे हैं और ऊंचाई व ठंडे क्षेत्रों के बागबानों को रोयल किस्मों के प्लांट मुहैया कराए जा रहे हैं।

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Sell or Rent
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Buy or Rent
Sell or Rent

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Register a new profile
Groom
Search profiles
Register a new profile
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Find wedding services
Offer wedding services

JOB

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Look for a job
Advertise jobs available
Unskilled
Look for a job
Advertise jobs available

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Buy
Sell
Truck/Bus
Buy
Sell
Two Wheeler
Buy
Sell

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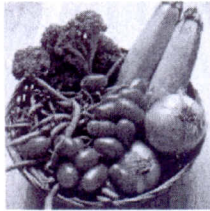
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Other
Miscellaneous
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संपर्क
विज्ञापन

हिमाचल की सच्चियां उगलेंगी सोना



नई दिल्ली — एमिटी विश्वविद्यालय नोएडा उत्तर प्रदेश के वैज्ञानिकों ने एक ऐसी नई फंगस की खोज की है, जो कि हिमाचल के पहाड़ी क्षेत्रों में फूलगोभी, शिमला मिर्च तथा टमाटर जैसी फसलों के विकास तथा पैदावार को बढ़ाने में मददगार साबित होगी। भारत सरकार के कृषि मंत्रालय के संस्थान राष्ट्रीय जैविक खेती केंद्र ने इस फंगस के फसलों में प्रयोग के लिए मंजूरी प्रदान कर दी है। विश्वविद्यालय के महानिदेशक केएस बैस ने बताया कि एमिटी इंस्टीच्यूट आफ माइक्रोबाइल टेक्नोलॉजी के वैज्ञानिकों द्वारा किए गए शोध से विकसित इस फंगस को पिरिफोरमोसपोरा इंडिका का नाम दिया गया है। इस फंगस का कांगड़ा तथा कुल्लू जिला के 125 किसान लगभग 150 कनाल भूमि पर फसल की पैदावार तथा गुणवत्ता बढ़ाने का सफल परीक्षण कर चुके हैं। उन्होंने कहा कि इन दोनों जिलों में उक्त फंगस के प्रयोग से फसलों को हानिकारक जीवाणुओं से बचाने में मदद मिली है। इससे किसानों की कीटनाशकों आदि पर निर्भरता भी कम हुई है। उन्होंने बताया कि फंगस का फलीदार, औषधीय तथा आर्थिक दृष्टि से महत्वपूर्ण पौधों पर प्रयोग किया गया, जिससे इन पौधों के बायोमास उत्पादन वृद्धि में उत्साहजनक परिणाम सामने आए हैं। उन्होंने बताया कि एमिटी विश्वविद्यालय हिमाचल में सब की फसल को रोगों से बचाने, फसल की पैदावार तथा गुणवत्ता में बढ़ोतरी के लिए सब उत्पादक क्षेत्रों में इसे प्रारंभिक तौर पर बागबानों को मुफ्त प्रदान करेगी। उन्होंने बताया कि एमिटी विश्वविद्यालय ने लाहुली पोर्टो सोसायटी मनाली को इसके वितरण के लिए नोडल एजेंसी तैनात किया है तथा निकट भविष्य में अतिरिक्त एजेंसियों को भी नियुक्त किया जाएगा।

January 30th, 2012

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किसानों को बीजों की जानकारी संबंधी कैंप लगाया

**विज्ञान एंड टेक्नोलॉजी
विभाग नई दिल्ली व अमृती
यूनिवर्सिटी ने लगाया कैंप**

नूरपुर बेदी, 16 अक्टूबर (मनदीप बाली): संस्था सोशल वर्क एंड रूरल डिवेलपमेंट सेंटर नूरपुर बेदी में किसानों को तेल युक्त बीजों की फसल की स्थिर कृषि करने संबंधी अहम जानकारी प्रदान करने के लिए विज्ञान एंड टेक्नोलॉजी विभाग नई दिल्ली भारत सरकार और अमृती यूनिवर्सिटी द्वारा विशेष प्रशिक्षण कैंप लगाया गया। संस्था के डायरेक्टर जगतार सिंह की अध्यक्षता में आयोजित किए गए ब्लाक सत्रिय सिखलाई कैंप दौरान जिला प्रशासन की तरफ से अतिरिक्त डिप्टी कमिश्नर रूपनगर ए.डी.सी. जनरल करणेश शर्मा विशेष रूप से उपस्थित हुए। इस मौके सम्बोधित करते हुए ए.डी.सी. शर्मा ने कहा कि किसान आर्थिकता को मजबूत बनाने के लिए



कैंप दौरान मंच पर बिराजमान ए.डी.सी. शर्मा और सम्बोधित करते जगतार सिंह।

आधुनिक खेती तकनीकों को अपनाएं उन्होंने कहा कि यूनिवर्सिटीयों ऐसे यत्न और तकनीकों को विकसित करें जिस से किसानों की आर्थिकता मजबूत हो सके। उन्होंने किसानों की अपील की है कि वह इन सिखलाई कैंपों का लाभ उठाकर खेती के कार्य में सुधार लाएं और फसलों की पैदावार बढ़ाने के लिए रसानायिक खादों और दवाईयों का कम प्रयोग करें इस मौके अमृती यूनिवर्सिटी से पहुंचे डा.

अमृत सी खड़गवाल ने बताया कि उनकी यूनिवर्सिटी के विज्ञानकों द्वारा ऐसा बाईऑ फर्टीलाइजर तैयार किया है जो पानी को पौदे तक पहुंचाता है संस्था खेती विरासत नंगल से पहुंचे सुरिन्द्र सिंह ने कहा कि समय था जब पंजाब खुशहाल प्रदेशों में शामिल था मगर अब किसानों की हालत खराब हो गई है और वह कर्जे की मार में आत्म हत्या कर रहे है साईस एंड टेक्नोलॉजी विभाग नई दिल्ली की

हैड मैडम आभा अग्नीहोत्री ने कहा कि गोभी, पत्तागोभी और हरी बरोकली में काफी मात्रा में ऐंटी आक्साइड होते हैं जो तनाव में कम करने में सारथिक होते हैं।

उन्होंने कहा कि बाकी तेलों की बजाए सरसों के तेल का प्रयोग अधिक फायदेमंद होता है आई.आई.टी. नई दिल्ली से आए माहिर हरी प्रशाद ने कहा कि विभिन्न प्रदेशों की ज़मीन में विभिन्न तरह के पौष्टिक तत्व पाए जाते हैं जिस पर आई.आई.टी. रिसर्च कर रही है कैंप दौरान आए किसानों को मुफ्त सरसों के बीज और दवाईयां भी प्रदान की गई संस्था के डायरेक्टर जगतार सिंह ने आए अतिथियों का अभार जताया। इस मौके नायब तहसीलदार केसी दत्ता, मैडम वीना जोशी, हरभजन सिंह, महिन्द्र सिंह, डायरेक्टर जगतार सिंह, मंगल सिंह, राजपाल, मैडम राम प्यारी, गुरबख्श कौर, अशोक कुमार, रीना राणी डा. राकेश ढूढ सहित भारी संख्या में किसान उपस्थित थे।

खेती प्रशिक्षण से अवगत करवाया साइंस एंड टेक्नोलॉजी डिपार्टमेंट नई दिल्ली ने लगाया प्रशिक्षण कैंप

♦ सब्सिडी पर मिलने वाले बीजों के बारे में जानकारी दी

संवाद सहयोगी, नूरपुरबेदी: किसानों को टिकाऊ खेती संबंधी जानकारी प्रदान करने के लिए संस्था सोशल वर्क एंड रूरल डेवलपमेंट सेंटर नूरपुरबेदी की ओर से भारत सरकार के साइंस एंड टेक्नोलॉजी विभाग नई दिल्ली एवं अमिती यूनिवर्सिटी के सहयोग से प्रशिक्षण कैंप लगाया गया। संस्था के निदेशक जगतार सिंह की अगुवाई में आयोजित समागम के दौरान विशेष रूप से उपस्थित हुए अमिती यूनिवर्सिटी के डॉ. अमित सी खड्गवाल ने कहा कि प्राकृतिक ढंग से की जाने वाली खेती ही टिकाऊ खेती है, जिससे वातावरण को किसी भी तरह से नुकसान नहीं पहुंचता है। निदेशक जगतार सिंह ने कहा कि रासायनिक खादों के प्रयोग



नूरपुरबेदी में प्रशिक्षण कैंप के दौरान किसानों को जागरूक करते हुए खेतीबाड़ी विशेषज्ञ।

की बजाय देसी खादों का प्रयोग किया जाए, जिससे जमीन के पौष्टिक तत्व बढ़ जाते हैं। सहायक इंस्पेक्टर खेतीबाड़ी विभाग शमशेर सिंह ने किसानों को सब्सिडी पर मिलने वाले बीजों संबंधी जानकारी प्रदान की। किसानों को खेत की मिट्टी की जांच करवाने के लिए प्रेरित किया। उन्होंने बताया कि मक्की की फसल को पोटोश खाद डालने पर झाड़ में बढ़ोतरी होती है। पंजाब स्टेट कौंसिल फॉर

साइंस एंड टेक्नोलॉजी चंडीगढ़ से पहुंची कुमारी वसुंधा शर्मा ने गन्ने एवं यामुन से प्राकृतिक सिरका बनाने एवं इसके प्रयोग करने से होने वाले लाभों से अवगत करवाया।

पंजाब स्टेट कौंसिल से पहुंची कुमारी ईशा दत्ता ने लैमन ग्रास और गुलाब से तेल प्राप्त करने संबंधी बताया। उन्होंने बताया कि गुलाब से तीन प्रकार के उत्पाद जिनमें तेल,

गुलाब जल एवं गुलकंद बनाए जा सकते हैं। इस कैंप दौरान विभिन्न गांवों के करीब 150 किसानों ने खेती विशेषज्ञ से भरपूर ज्ञान हासिल की।

इस मौके पर मास्टर संतोख सिंह, राज कुमार, राणा वरिन्द्र सिंह, रोशन लाल सरपंच, हरभजन सिंह, दीवान सिंह, जगदीश राम मवा, शिंगारा सिंह बैस एवं मोहन सिंह भैणी व किसान मौजूद थे।

जागरण

एमिटी विश्वविद्यालय में तकनीक का हस्तांतरण

बि. नोएडा : सेक्टर-125 स्थित एमिटी विश्वविद्यालय में बुधवार को डा. अमित खरकवाल द्वारा विकसित तकनीक का हस्तांतरण किया गया। एमिटी माइक्रोबियल टेक्नोलॉजी के उपनिदेशक ने एंटीफाइटिक एक्टिविटी आफ टालारोमायसेस परपरियोजेनेस एचएनबी9 पर तकनीक विकसित की है। यह कवक पौधे में फास्फेट, जिंक, सिलिकान, आयरन आदि बढ़ाकर उनकी गतिविधियों को प्रोत्साहित

करता है। शोध के दौरान देश में कई स्थानों पर इस आदर्श बायोएजेंट का उपयोग किया गया। एग्रीमेंट पर वैदिक विज्ञान क्रिएशन एलएलपी के संस्थापक भागीदार आरके सिंघल और एमिटी के कुलसचिव डा. बीएल आर्या ने हस्ताक्षर किए। इस मौके पर मयंक सिंघल, नीरज सिंघल, डॉ. दिलीप जे उपाध्याय, एआइएमएमएसीआर के चेयरमैन डा. बीसी दास, मीनाक्षी कनौजिया आदि मौजूद रहे।

Research Projects on Novel Fungal Root Endophytes

SN	Name of the Principal Investigator(s)	Title of the project	Funding Agency	Total Approved Budget (Rs.)	Sanction Order No.	Date of Sanction	Duration (Status)
1.	Dr. Amit C Kharkwal	Development of Bioformulation Based on Novel Root Endophyte <i>Talaromyces purpureogenus</i> HNB9 for Plant Growth Promotion and Biocontrol of <i>Fusarium</i> spp.	DBT	28.578 lakhs	BT/ATGC/127/SP4 2382/2021	03-05-2023	2 Years (Ongoing)
2.	Dr. Naveen Chandra Joshi	Phosphate controls the fate of root meristems to regulate root system architecture in plants	DST/SERB-SRG	26.108 lakhs	SRG/2020/00223 7	24-1-2020	2 years (Ongoing)
3.	Dr. Neeraj Shrivastava	Synergistic impact of symbiotic fungus <i>Piriformospora indica</i> and PGPRs in promoting <i>Stevia rebaudiana</i> growth and its secondary metabolites	CSIR	23 Lakhs	60(0121)/20/EMR -II	17-09-2020	3 years (Ongoing)
4.	Dr. Ajit Varma	Training of Rajasthan rural women on use of biofertilizer for crop productivity enhancement	DSIR – TDUPW Scheme	33.53341 lakhs Amity = Rs. 15 lakhs AFRI Rs. = 18.53 lakhs	DSIR/TDUPW/124 /2017-18	12-12-2018 Grants received date	18 months (Completed)
5.	Dr. Swati Tripathi	Investigation of molecular mechanism of <i>Piriformospora indica</i> interaction and bio-protection in the 'Patho-system tomato-fusarium	SERB - DST	24.5256 lakhs	ECR/2017/000697	29-05-2017	3 years (Completed)
6.	Dr. Ajit Varma	To understand the mechanism of Zinc Oxide Nanorods on fungus and plant productivity	DST (Nano Mission)	42.59688 lakhs	SR/NM/NB-1039/2016	06-03-2017	3 years (Completed)
7.	Dr. Ajit Varma	Biofortification of Wheat and Maize with Zinc and Iron Using Endophytic Microorganisms	NASF - ICAR	143.8029 Lakh AUUP = 91.2296 lakhs	NASF/Mn-5019/2016-17	27-02-2017	3 years (Completed)
8.	Prof. Dr. Ajit Varma / Dr. Amit C Kharkwal	Funds for Improvement of S&T Infrastructure in Universities & Higher Educational Institutions – FIST Program 2014	DST FIST	Rs 110 lakhs	FT/12/02(96)/14/1128	21-11-14	5 years (Completed)
9.	Dr. Manoj Nath	Investigating the effect of <i>Piriformospora indica</i> on root architecture and growth response of salt tolerant and susceptible rice varieties under salinity stress	SERB – DST	45.19 lakhs	ECR/2016/000653	20-02-2017	3 years (To be Transferred)
10.	Prof. Dr. Ajit Varma / Dr. Neeraj Shrivastava / Dr. Sangeeta Singh & Dr. P.S Chauhan (AFRI)	Value addition to plants of agricultural and horticultural importance by application of consortium of root fungal endophyte and nitrogen fixing prokaryote – <i>Azotobacter</i> spp	DST- SEED	18.64 lakhs 9.81 lakhs (Amity)	SEED/TIASN/ASAR -001/2012(G)	06-05-15	2 years (completed)
11.	Dr. Amit C Kharkwal	Mediation of Root Endophytes for Sustainable Agriculture and	DST (SARTHI)	7.5284 lakhs	SEED/SARTHI/PU N/08/2012/G	30-09-15	2 years 11 months (completed)

SN	Name of the Principal Investigator(s)	Title of the project	Funding Agency	Total Approved Budget (Rs.)	Sanction Order No.	Date of Sanction	Duration (Status)
		Forestry in Kandi Region of Punjab					
12	Mr. Ajit Chauhan, Director, Krauter Healthcare Ltd Dr. Ajit Varma Dr. Amit C Kharkwal	Pilot Scale Production of Plant Promoting Fungus <i>Piriformospora indica</i> : A step forward towards Commercialization	SBIRI	40 lakhs 20 Lakhs (Amity)	BT/SBIRI-1161/SBIRI-22/13	05-12-14	3 years (Completed)
13	Dr. Ajit Varma	Interaction of Nano-embedded <i>Piriformospora indica</i> with the plant of medicinal importance, <i>Brassicca oleracea</i> var. <i>Botrytis</i> (Broccoli)	BIRAC, DBT	32.50 lakhs	SR/FST/LSI-590/2014	26-08-14	2 years (Complete)
14	Dr. Aparajita Das	Effect of root endosymbiotic fungus <i>Piriformospora indica</i> and selected AMF (Arbuscular Mycorrhiza Fungus) on growth and biological control against Fusarium wilt of Tomato and Spinach	SERB-DST	12.80 lakhs		12.08.13	3 years (Complete)
15	Dr. Ajit Varma (AUUP) Dr. KK Pal, Directorate of Groundnut Research, Junagarh Dr. Devidayal, CAZRI, Regional Research Station, Kukma, Bhuj	Unravelling biochemical and molecular basis of bacterial and fungal endo-symbiosis for management of abiotic stresses in plants	ICAR	Rs. 249.26 lakhs AUUP = Rs 71,97,190/-		24.05.11	5 years (Complete)
16	Dr. Ajit Varma (PI) Dr. Amit C Kharkwal (Co-PI) Dr. Ram Prasad (Co-PI)	Studies on Enhancement of Soil Genesis and Fertility by Microbes in Degraded Land in Semi Arid and Middle Hill Conditions	Life Sc Research Board, DRDO	23.73360 lakhs		22.03.12	3 years (Complete)
17	Dr. Ajit Varma (AUUP) Dr. Debabrat Baishya (Institute of Science & Technology, Guwahati University)	Value addition and in-vitro induction of active principle in <i>Artemisia annua</i> and <i>Tinospora cordifolia</i> after co-cultivation with microbial consortium	DBT (Under DBT's Twinning Program for NE)	Rs. 42.53 lakhs AUUP = Rs 17,50,000/-		08.03.11	2 years (Complete)
18	Prof. Dr. Ajit Varma (AIMT-AUUP); Prof. Dr. K.C. Upadhyaya (AIB-AUUP); Prof. Dr. P.K. Yadava (JNU)	Molecular Studies on Interaction of <i>Piriformospora indica</i> and Rhizobacteria (jointly with JNU)	DBT	Rs. 69.23 lakhs AUUP = Rs 27.76 lakh		13.11.09	3 years (complete)
19	Dr. Ajit Varma	Proteomics of Excessive Production of Artemisinin from high yielding varieties of <i>Artemisia annua</i> co-cultivated with a novel symbiotic fungus	DRDE (DRDO) – Gwalior	Rs. 14.87 lakhs		18.10.10	2 years (Completed)
20	Dr. Ajit Varma	Growth analysis of value addition of some cultivated plants on interaction with multifunctional symbiotic fungus <i>Piriformospora indica</i>	DIHAR, Leh (DRDO), Ministry of Defence	Rs. 9.91 lakhs		06.03.09	2 years (Completed)

SN	Name of the Principal Investigator(s)	Title of the project	Funding Agency	Total Approved Budget (Rs.)	Sanction Order No.	Date of Sanction	Duration (Status)
21	Dr. Amit C Kharkwal	Phytoremediation of saline soils by novel Arbuscular mycorrhiza-like-fungus for value addition and growth promotion of selected medicinal plants	Ministry of Environment & Forests	Rs. 29.8418 lakhs		11.11.08	3 years (Completed)
22	Dr. Ajit Varma	Exploring the role of <i>Piriformospora indica</i> as bioherbicide and value addition to Naga Chilli of North East India	DRL (DRDO), Tezpur (Assam), Ministry of Defence	Rs. 9.996 lakhs		19.03.09	2 years (Completed)
23	Dr. Shwet Kamal / Dr. Sangeeta Mehta DasGupta	Interaction of Microfungi and Rhizobacteria for enhancement of Biomass and Secondary Metabolites of <i>Bacopa monniera</i> for Therapeutically Valueable Agent	CSIR	Rs. 18.53 lakhs		14.11.05	3 years (Completed)
24	Dr. Ajit Varma (AUUP), Dr. S.B. Chincholkar (North Maharashtra University, India); Dr. G.K. Podila (US)	Expression of microbial iron chelators in fungus and wheat: A solution to global iron deficiency (Indo-US Collaborative Project)	DST-NSF	Rs. 2 lakhs		19.10.06	3 years (Completed)