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Population Dynamics of *Phytophthora infestans* in India

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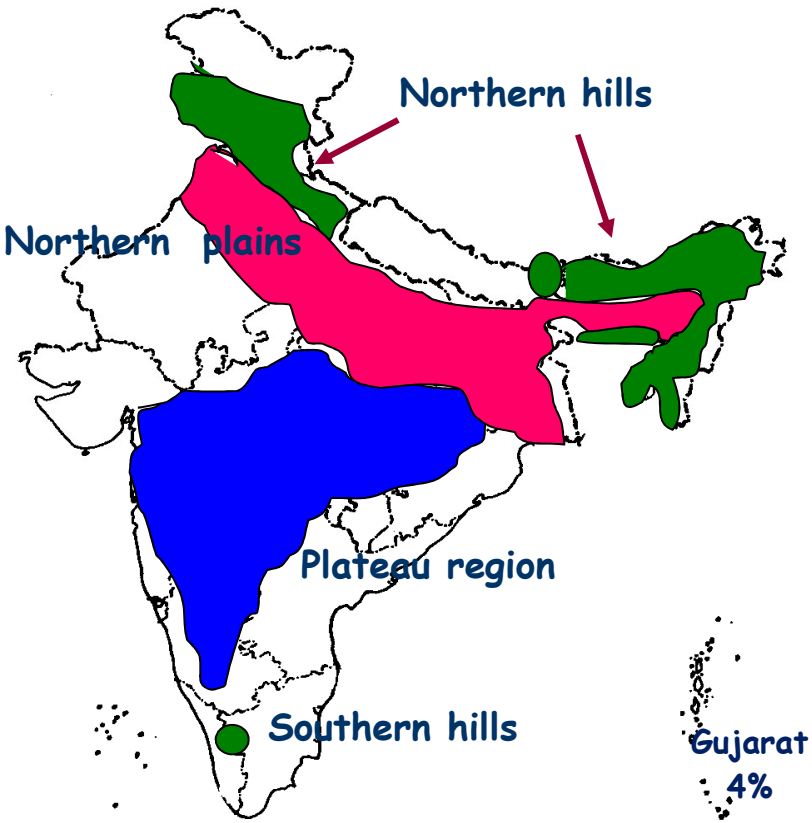
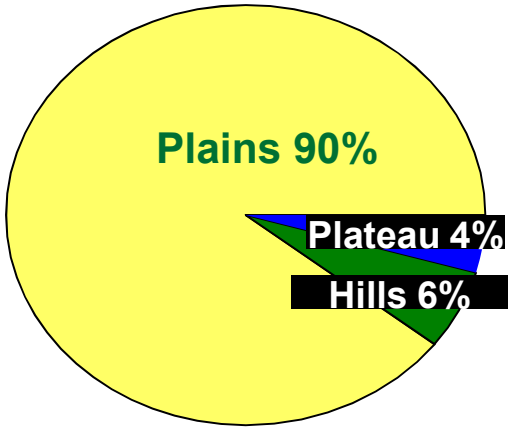
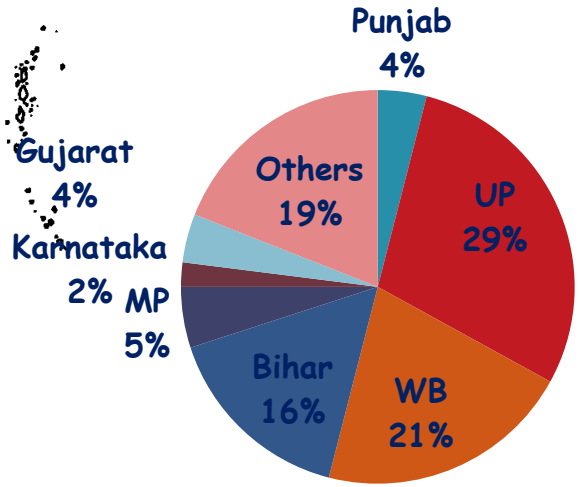
Status of Potato in India

Area: 2.16 m ha
Production: 53 mt
Productivity: 23t/ha







Per cent area (million ha) under potato in different states of India

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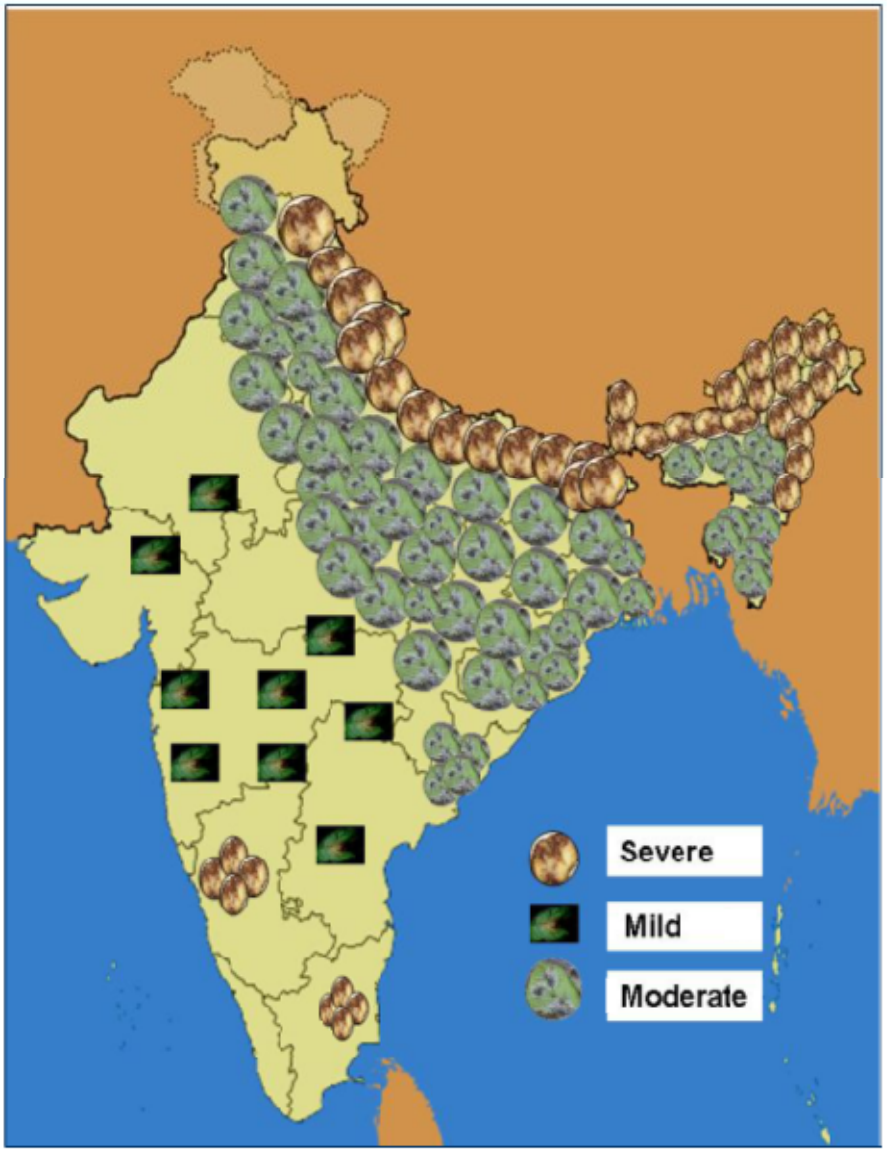
Distribution of late blight



Eastern Hills	19-90%
NW Hills	11-90%
Southern Hills	31-80%
N W Plains	20-90%
Eastern Plains	10-85%
Plateau	50-100%
Av crop loss	15%

7.9 million tonne

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Pathogen Variability and its Relevance in Late Blight Management

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P. infestans is highly variable:

- Changes with host genotype, environment and management practices
- It calls for regular monitoring of variability i.e. physiological races, mating types, fungicide sensitivity, mt haplotypes, SSRs etc.

Variability in *Phytophthora infestans*

- **Phenotypic Markers**
  - Races (1958)
  - Mating types (1986)
  - Fungicide resistance (1989)
- **Genetic Markers**
  - Isozymes
  - Ploidy
  - RAPDs
  - Mt.DNA
  - SSR
  - RFLP
  - AFLP

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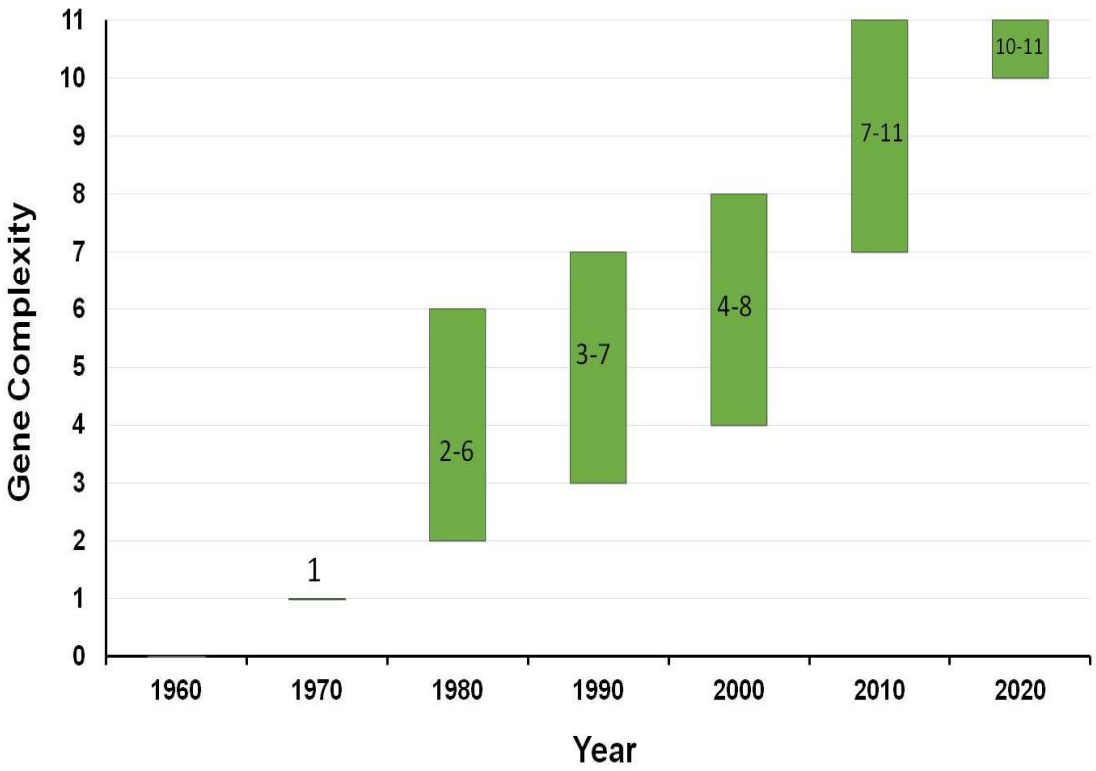
Phenotypic Diversity: Race Spectrum

- *Presently P. infestans* population is composed of most complex races (10-11 virulence genes)



Location	Race
HP hills	11
UP	10-11
Karantaka	11
Uttarakhand	11
Tamil Nadu	11
West Bengal	10-11
Punjab	11
Meghalaya	11
Assam	11
Bihar	11
Rajasthan	11

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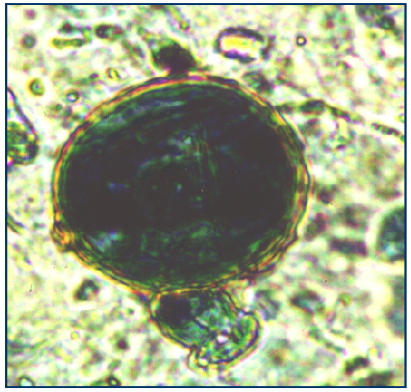
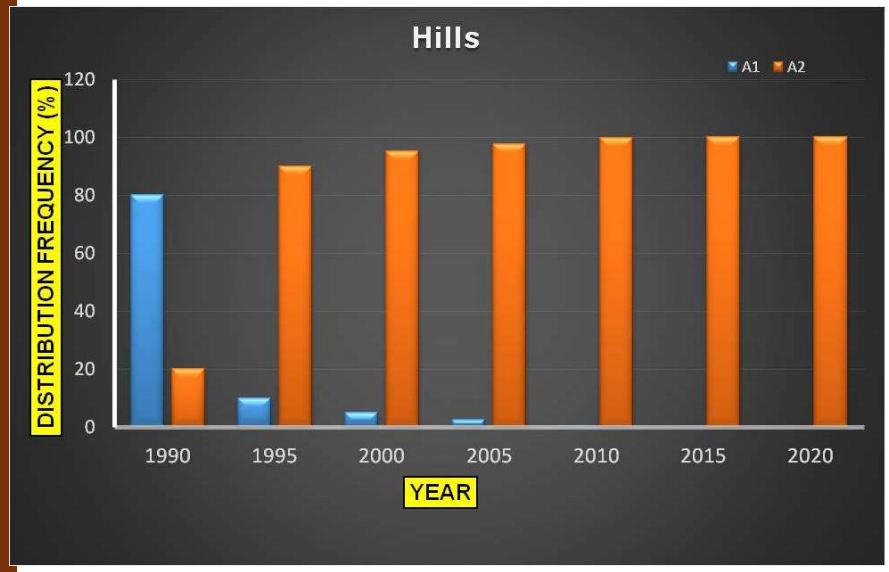
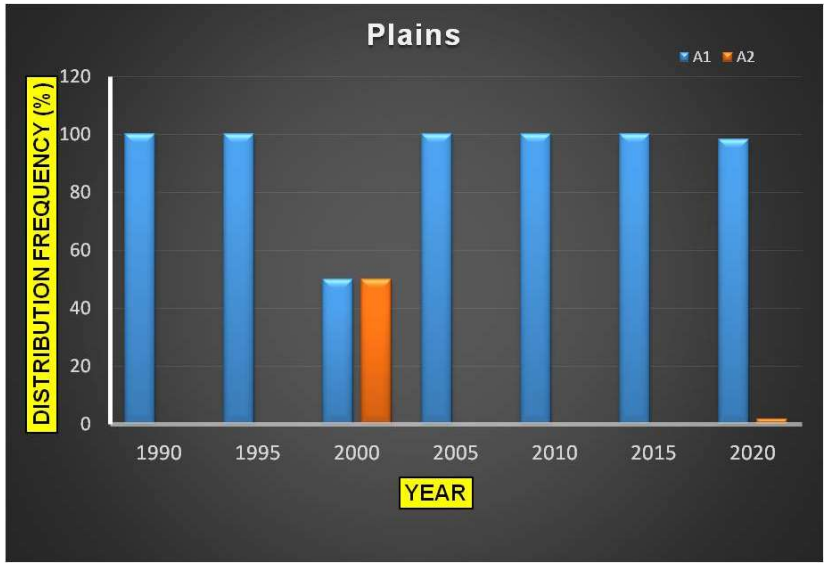
Phenotypic Diversity: Mating Type







Uptill 1986 only A_1 was present in India

Hills – A_2 dominant

Plains – A_1 dominant

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Phenotypic Diversity: Metalaxyl sensitivity

Year	North western hills			North eastern hills			Indo-Gangetic plains		
	Tolerance at ppm level (% isolates)								
	100	200	400	100	200	400	100	200	400
2001-02	15	0	0	10	0	0	0	0	0
2004-05	13	0	0	5	0	0	8	0	0
2006-07	100	75	11	32	0	0	71	58	38
2007-08	100	90	17	32	0	0	60	45	0
2008-09	100	86	39	100	33	0	60	54	22
2009-10	100	68	0	100	100	0	80	20	-
2010-11	100	100	0	100	100	83	100	67	0
2011-12	100	100	1	-	-	-	100	100	0
2012-13	100	100	0	100	100	0	100	100	0
2015-16	100	88	0	100	100	0	100	100	0
2016-17	100	90	0	-	-	-	100	80	0

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Phenotypic Diversity: Ploidy Status

Region	Polyploids (%)		
	Diploid	Triploid	Tetraploid
North -western hills	38.2	43.2	18.6
North-eastern hills	60.0	40.0	0.0
Indo-Gangetic plains	50.0	37.5	12.5

During 2008-2014			
North -western hills	91	6	3
North-eastern hills	89	11	0
Southern hills	75	25	0
Indo-Gangetic plains	74	20	6
Plateau	100	0	0

P. infestans in India is polyploid consisting of diploids, triploids and tetraploids

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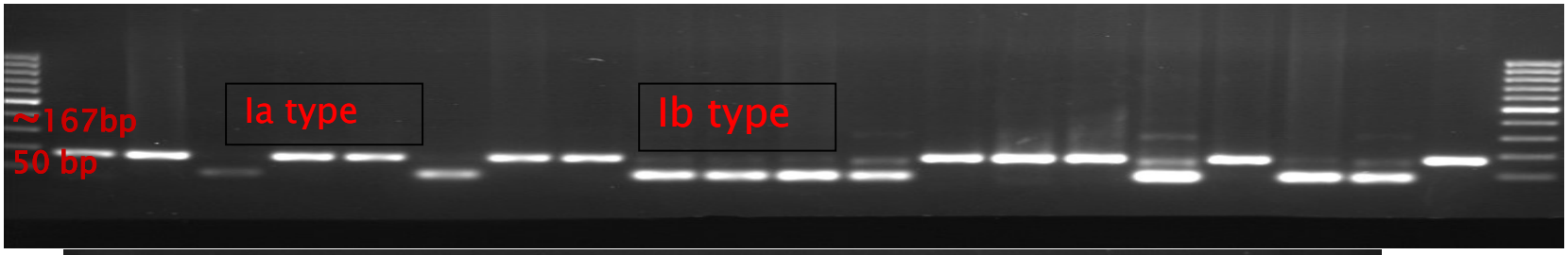
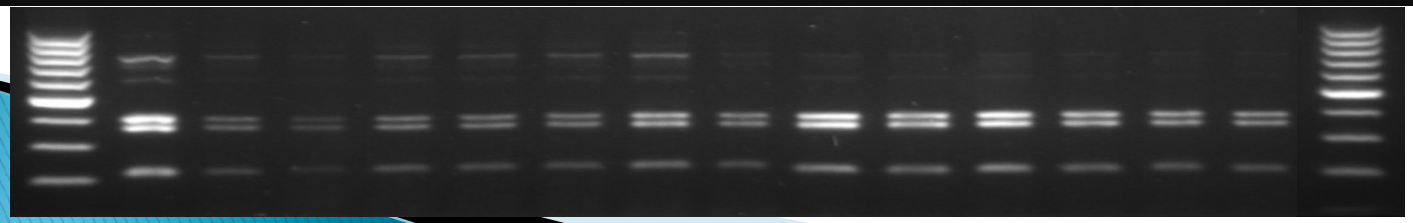
Genotypic Diversity: Mitochondrial haplotypes

Year	Haplotype			
	Ia	Ib	IIa	IIb
1996-2001	-	+	-	-
2002	+	+	-	-
2003	-	+	-	-
2004	+	+	-	+
2005	+	-	-	-
2008-09	+	+	-	-
2009-10	+(62.5%)	+ (37.5%)	-	-
2010-11	+ (76%)	+ (24%)	-	-
2011-12	+ (100%)	-	-	-
2012-13	+ (100%)	-	-	-
2013-14	+ (100%)	-	-	-





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Genotypic Diversity: SSR genotyping

Variation in the observed and actual allele size (bp) of *P. infestans* isolates amplified with SSR markers

	Marker/Allele size (bp)													
	Pi02	Pi04	Pi16	Pi26	Pi33	Pi56	Pi63	Pi65	Pi66	Pi70	Pi89	4B	G11	D13
Observed size	132-170	152-202	188-221	180-200	205-221	160-228	147-186	141-160	134-160	163-191	170-208	194-228	151-159	108-168
Actual size	142-166	162-170	174-178	172	203-209	174-176	148-160	145-151	153-155	189-195	179-185	205-217	142-166	108-142

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Genotypic Diversity: SSR genotyping

HP-08-59

	Size bp	G11	Pi02	SSR11	D13	SSR8	SSR4	PiO4	Pi70	SSR6	Pi63	SSR2	Pi4B
	Dye	Yellow/ Black NED	Blue FAM SSR3/	Green VIC	Yellow/Black NED	Blue FAM	Green VIC	Yellow/ Black NED	Blue FAM	Green VIC	Green VIC	Yellow/ Black NED	Blue FAM
1	360												
2	355												
3	350												
4	345												
5	340			1									
6	335												
7	330												
8	325												
9	320			341									
10	315												
11	310												
12	305												
13	300												
14	295						1						
15	290												
16	285						1						
17	280										1		
18	275						284						
19	270		1				294				1		
20	265		1			1							
21	260					1					263		
22	255										279		
23	250		266										
24	245		268							1			
25	240									1			
26	235					260							
27	230					266							
28	225												
29	220									240			
30	215									244			1
31	210												
32	205												1
33	200												
34	195								1				205
35	190												213
36	185								192				
37	180												
38	175												
39	170							1				1	
40	165							1					
41	160	1			1								
42	155							166				170	
43	150	1`						170					
44	145												
45	140												
46	135				1								
47	130												
48													
49	120												
50	115												
51	110	152											
52	105	158											
53	100												

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Thank you

The Organizers for the invite----

----- and to everyone else for listening