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Plant disease management technology adoption and its impact on crop production in Himachal Pradesh

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Abstract

A total of 39 plant diseases mainly caused by fungal pathogens were identified on major field and vegetable crops grown in Himachal Pradesh. Some diseases (loose smut, yellow rust and brown rust of wheat) were widespread occurring throughout the state while others were restricted to specific areas only. The technology adoption was comparatively less in cereals (except loose smut of wheat management 50-60%), pulses and oilseeds as compared to vegetables especially in cash crops. Yield increase was as high as 80 per cent in tomato, ginger and brinjal. Economics of technology adoption also revealed a maximum net return in tomato (Rs.1, 77,595 /ha) followed by pea and potato.

Key words: Disease management, crop production, technology adoption, impact.

Introduction

Plant diseases can dramatically reduce crop yields and the impact of disease outbreaks is particularly acute in those regions, where management strategies are not followed. In Himachal Pradesh, almost all the major field and vegetable crops are threatened by a multitude of pathogens. Oerke *et al.* (1994) estimated 14.2 per cent crop losses due to plant diseases in Asia in 1988-90. It has been estimated that about 10 per cent losses occur annually by plant diseases which may go up to 30- 50 per cent for major crops where the access to disease management methods is limited. Sometimes complete loss of the crop has been recorded for example bacterial wilt of solanaceous crops (tomato, brinjal, capsicum) in isolated pockets where no management practices were followed. In Himachal Pradesh, Department of Plant Pathology, CSK HPKV Palampur since its inception in 1985 is playing a key role in the disease diagnosis, disease management and fungicide application methodology. Success stories in integration of different strategies have led to an increased adoption of technology by farmers resulting in both quantitative and qualitative increase in crop yields. This paper deals with intervention of management technologies, their adoption and economic aspects in Himachal Pradesh.

Material and Methods

The disease survey and surveillance reports for the last ten years (1997-2007) of the department were referred and major diseases of cereals, oilseeds, pulses and vegetable crops were enlisted with their distribution pattern in the state (Anonymous, 1997-2007). The management technologies developed for specific disease(s) were also ascertained from Package of Practices for *Kharif* and *Rabi* crops and vegetable crops, published by Directorate of Extension Education CSKHPKV Palampur from time to time (Anonymous 2000-2007). Estimates were made in the adoption per cent and increased yield in each crop based on authoritative statements of experts of each crop diseases and also feedback from extension workers and farmers. Economics of these technologies were analyzed in detail.

Results and Discussion

The survey and surveillance reports revealed that there were 39 major diseases (Table 1) of field and vegetable crops, responsible for limiting their production. Some of the diseases viz; loose smut, yellow and brown rusts of wheat, Turcicum and banded leaf and sheath blight of maize were found throughout the state whereas some diseases were very specific to some regions / areas. Rice bacterial blight and downy mildew of onion were restricted to Kangra district, but may spread to other areas owing to their seed borne nature. Karnal bunt of wheat was mainly restricted to foot hills of the state but now even reported from mid hills (Rana *et al.* 2008). Bacterial wilt of tomato was found predominantly in Kangra, Mandi, Hamirpur, Kullu and Solan districts whereas root rot/wilt disease complex of pea was predominant in Zone IV of the state especially Lahaul and Spiti district. Rhizome rot of ginger was recorded from Sirmour, Bilaspur and Una districts. Anthracnose of rajmash was not recorded from Lahaul & Spiti and parts of Kinnaur district. So seed production of rajmash and French bean

can be done in these areas for avoiding the seed infection by *Colletotrichum lindemuthianum* causing anthracnose disease.

Adoption of technology and increase in crop yields

Impact of crop diseases, their management and benefit to farmers (Table 2) revealed that significant increase in yield was achieved by adoption of recommended technology especially in case of major diseases of crops. Yield increase varied from 1-2 per cent by Karnal bunt management to 5-10 per cent by loose smut management. Adoption of technology by farmers was maximum (50-60 %) for the control of loose smut of wheat by seed treatment. In maize, application of bleaching powder increased yield by 40-60 per cent but adoption rate was comparatively low (5-15 %). In rice blast management, yield increased from 10-20 per cent with 30-50 per cent adoption rate, especially neck blast management (Table 2). In cereals generally farmers were found reluctant to adopt protection technology except in managing loose smut of wheat because of low value of crops. In pulses comparatively the increase in yield by adopting disease management technology varied from 5-20 per cent but adoption rate was very low (3-5 %). Similar situation was observed with oilseed crops especially in case of Alternaria blight management.

In vegetable crops, scenario was altogether different. Invariably the increase in yield varied from 5-10 per cent (Colocasia) to as high as 60- 80 per cent (ginger and brinjal) with equally higher adoption rate of technology i.e. 80 per cent in tomato, 50-70 per cent in potato and 20-50 per cent in brinjal (Table 2). In garlic, the increase in yield ranged from 10-30 per cent by managing Stemphylium blight with 30-50 percent adoption rate especially when outbreaks of this disease occurred. However in French bean/ rajmash though increase in yield varied from 20-30 per cent by managing anthracnose disease but adoption rate was comparatively very low (5-10 %).

Economics of adoption of disease management technology

Economic analysis of technology adopted by the farmers was made by estimating total area, per cent area adopted, increase in yield, technical intervention, net gain per ha and total net gain (Table 3). In wheat out of total area (3,78,000 ha) at 50-60, 10-15 and 5-10 per cent technology adoption rate of management technology of loose smut, Karnal bunt and hill bunt, respectively the net gain/ha was Rs 466, 6125 and Rs.492 with total estimated net gain of Rs. 969.28 lakh Rs. 2878.8 lakh and 137.8 lakh, respectively (Table 3). In maize it was Rs. 1358.1 lakh and in rice Rs. 1389.5 lakh, with net per ha gain of Rs. 4557, and Rs 4236, respectively.

In pulses, a net total gain of Rs. 1.54 lakh in chickpea and Rs 6.5 lakh in urdbean with a net gain per ha of Rs 1925 and Rs 775 were realized. Whereas, in case of rapeseed and mustard total net gain was Rs. 2.23 lakh with net gain of Rs 270 per ha.

In vegetables, maximum net total gain was Rs 32772 lakh with a net gain of Rs 1,77,595/ha in tomato followed by potato (Rs.2025 lakh) with a net per ha gain of Rs 22,5 00 and pea (Rs1089 lakh) with gain of Rs. 22,687 per ha.

So it is evident from these observations that adoption of plant disease management technology was invariably high in cash crops especially of vegetable crops and increase in yields were very high which has convinced the farmers for adopting these economically viable technologies.

Table 1. Major plant diseases limiting the crop production in Himachal Pradesh

Crop	Disease	Prevalence in the districts
Cereals		
Maize	Bacterial stalk rot	Sirmour, Una, Hamirpur, Bilaspur, parts of Mandi and Kangra
	Turcicum and maydis leaf blights	Throughout the state
	Banded leaf and sheath blight	Throughout the state
Paddy	Blast	Kangra and Mandi
	Brown spot	Sirmour, Bilaspur, Solan, Una, parts of Kangra and Mandi, Kullu
	Grain discolouration	Throughout the state
	False smut	Sirmour, Bilaspur, Solan, Una, parts of Kangra and Mandi, Kullu
	Bacterial blight	Kangra
Wheat	Rusts (yellow & brown rusts)	Throughout the state
	Loose smut	Throughout the state

	Hill bunt	Kullu, Mandi, Solan, Shimla and parts of Kangra
	Karnal bunt	Sirmour, Una, Bilaspur, parts of Kangra
Oilseeds		
Brassica oil seeds	Alternaria blight	Kangra, Sirmour, Mandi, parts of Chamba
	White rust	Kangra, Sirmour, Mandi, parts of Chamba, Kullu, Bilaspur and Solan
	Downy mildew	Kangra, Sirmour, Mandi, parts of Chamba, Kullu, Bilaspur and Solan
Linseed	Rust	Kangra , parts of Mandi , Hamirpur, and Chamba
	Wilt	Kangra , parts of Mandi , and Hamirpur
Soybean	Brown spot	Kangra, parts of Mandi, Kullu and Hamirpur
	Target leaf spot	Kangra, parts of Mandi, Kullu and Hamirpur
	Yellow mosaic	Kangra, parts of Mandi, Kullu and Hamirpur
Vegetable crops		
Tomato	Bacterial wilt	Kangra, Mandi, Hamirpur , Kullu and Solan
	Buckeye rot	Kangra, Mandi, Hamirpur , Una, Sirmour and Solan
Cabbage and	Black rot	Solan, Mandi, Kullu, Shimla, Una, Sirmour and Kangra
Cauliflower	Stalk rot	Solan, Mandi, Kullu, Shimla, Una, Sirmour and Kangra
Cucurbits	Sudden wilt	Kangra, Una, and Hamirpur
Pea	Root rot/wilt complex	Lahaul & Spiti, Kinnaur, parts of Mandi and Kangra
	White rot	Lahaul & Spiti, Kinnaur, parts of Sirmour, Bilaspur, Mandi and Kangra
Brinjal	Bacterial wilt	Kangra, Mandi, Hamirpur, Solan and parts of Chamba and Kullu
	Phomosis blight & fruit rot	Kangra, Mandi, Hamirpur, parts of Chamba and Kullu
	Collar rot	Kangra, Mandi, Una, and Hamirpur,
Potato	Late blight	Shimla, Kangra, Mandi, Bilaspur, Una and parts of Sirmour, Kullu and Solan
	Bacterial wilt	Kangra and Mandi
Chilli and Capsicum	Bacterial wilt	Mandi, Kullu, Kangra, Solan and parts of Chamba and Hamirpur
	Fruit rot (Anthracnose)	Sirmour, Una, Bilaspur, Kullu, Mandi Solan and Kangra
Onion	Downy mildew	Kangra
Pulse crops		
Mash and Mung	Leaf spots	Kangra, Kullu, Bilaspur, parts of Mandi and Una
Rajmash	Anthracnose	Kullu, Mandi, and parts of Chamba and Kinnaur
Gram	Root rot and stem rot	Bilaspur, Una , and Sirmour
Ginger	Rhizome rot	Sirmour, Bilaspur and Una.

Table 2. Disease management technology adoption and increase in crop yield

	Crop	Disease	Technology developed*	Per cent increase in yield	Technology adoption (%)
Cereals	Wheat	Loose smut	Seed treatment with fungicide	5-10	50-60
		Karnal bunt	Spray tilt at boot leaf stage	1-2 (quality improvement)	10-15
		Hill Bunt	Seed treatment	3-5	5-10
	Maize	Bacterial stalk rot	Application of bleaching powder	40-60	5-15
	Rice	Blast	Seed treatment + foliar spray (Based on forecasting)	10-20	30-50
Pulses	Chickpea	Blight+ root rot	Seed treatment +foliar spray	15-20	3-5
	Urdbean	Leaf blight	Foliar sprays	5-10	3-5

Oilseeds	Rapeseed and mustard	Alternaria blight	Seed treatment +foliar spray	5-10	5-10
Vegetables	Potato	Late blight	Spray schedule	40-60	50-70
	Tomato	Bacterial wilt	Resistant varieties	70-90	80
	Onion	Downy mildew	Spray schedule	10-20	30-40
	Garlic	Stemphylium blight	Spray	10-30	30-50
	Ginger	Rhizome rot	Seed treatment	60-80	50-60
	Brinjal	Fruit rot and bacterial wilt	Resistant varieties + sprays	60-80	20-50
	Colocasia	Blight	Foliar sprays	5-10	5-10
	Pea	Powdery mildew	Sprays schedule	20-50 (quality improvement)	50-70
		Root rot/wilt	Seed treatment+ biological control	40-60	10-30
	Bean	Anthracnose	Seed treatment+ spray	20-30 + quality improvement	5-10

*With the changes in the races of the pathogen and climatic factors *vis- a-vis* introduction of new potent fungicides, technologies keep on changing/improving

Table 3. Economics of adoption of disease management technology

Crop	Disease (s)	Total area (ha)	Adoption area (ha)	Increase in yield/ha (Kg)	Technology cost/ha (Rs)	Increase in income (Rs)	Net gain/ha (Rs)	Total net gain (Rs lakh)
Wheat	Loose smut	378000	208000	116.6	700	1166	466	969.28
	Karnal Bunt	378000	47000	23.32	2000	8125	6125	2878.8
	Hill Bunt	378000	28000	62.2	130	622	492	137.8
Maize	Bacterial stalk rot	298000	29800	1021.5	1050	578	4557	1358.1
Rice	Blast	82000	32800	457.2	1250	5486	4236	1389.5
Chickpea	Blight + root rot	2000	80	140	1575	3500	1925	1.54
Urdbean	Leaf blight	19500	780	60	1025	1800	775	6.5
Rapeseed and mustard	Alternaria blight	11000	825	67.5	1080	1350	270	2.23
Linseed	Rust + wilt	3000	120	45	512	720	158	0.1896
Potato	Late blight	15000	9000	6000	7500	30000	22500	2025
Tomato	Bacterial wilt+ buckeye rot	23066	18453	18080	3205	180800	177595	32772
Onion and Garlic	Downy mildew +Stemphylium blight	2520	82	2550	6481	25500	19019	163.9
Ginger	Rhizome rot	2000	1100	8750	7000	13125	124250	1367
Brinjal	Fruit rot+ Bacterial wilt	252	88	7000	1540	28000	26460	23.3
Colocasia	Blight	11000	825	911	2563	5466	2903	23.9
Pea	Powdery mildew	8000	4800	2000	1313	24000	22687	1089
	Root rot/wilt complex	8000	1600	4000	1191	48000	46809	749
Bean	Anthracnose	2078	156	2375	1163	23750	22587	35.2

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