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Economics 0f Integrated Disease Management strategy in Rapeseed-mustard

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Introduction

India ranks second in area and fourth in world's production of oilseeds. Rapeseed-mustard contributes 26.1 per cent and 29.1 percent of the total area and production of the country, respectively. Rajasthan ranks first in area and Haryana ranks first in productivity of rapeseed-mustard. The stem rot disease of mustard (Sclerotinia sclerotiorum (lib.) de Bary), which was silent in the past has recently become a serious disease of rapeseed-mustard in Rajasthan and Haryana (up to 80% incidence and 40% losses in yield). The pathogen is reported to have a wide host range, infecting 64 plant families belonging to 225 genera and 383 species without a single proven source of resistance in any host up to this date. The pathogen is a soil inhibiting fungi, the resting stage (sclerotia) of which is capable to thrive well in fields during off season and infect the sown crop right from its seedling stage. The sclerotia germinate simultaneously with the advancing vegetative phages of the crop, burst to liberate the ascospores, which become the secondary source of inoculums in the development of stem rot disease. Obviously, the crop has to be protected initially from soil inoculums by seed or soil treatments, in standing crop through fungicidal sprays and post harvest strategies like removal of diseased stubbles. Mere use of pesticide in recent time has come under severe criticism because of several outstanding reasons. Thus it is apprehended that integration of possible technical interventions be suggested for substantially increased productivity through economically feasible disease management strategies. Prolonged use of chemical pesticides may be environmentally unsafe and hazardous to human health. The focus of plant protection is gradually shifting to alternate methods viz. bio-technological approach using micro-organisms (*Trichoderma* spp., VAM fungi, *Bacillus thuringiensis* etc.). Also, some anti-pathogen principles derived from plant origin have been recognized as important factor towards disease management (Sindhan and Hooda, 2004; Patni *et al*., 2005). Godika and Pathak (2009) have proved the efficacy of leaf extracts of five popular botanical against important diseases of mustard. These products have been reported successful when used in Integrated Disease Management (IDM) mode

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(Jairaj, 1989; Ram and Gupta, 1990; Srinivas and Krishnamoorthy, 1991; Singh, 1997; NCIPM, 1998)

Need for IDM in rapeseed-mustard

The rapeseed mustard crop is known to suffer from various serious diseases like white rust, Alterneria blight , Powdery and Downey mildews. The stem rot disease was however, not known in the recent past. It was reported from cooler countries and reports were confined to *Brassica napus.* Studies on the stem rot fungi in relation to Indian mustard *Brassica juncea* were limited. The occurrence of diseases in mustard is correlated to the nutritional supplement in soil. Basal application of potash (@40 kg/ha.) is reported to reduce diseases (Godika et al, 2001). The seed rate is also important as dense crop increase the severity of diseases. Besides these factors, the soil type, number of irrigations also play crucial role in disease epidemiology. Heavy soil with high humidity is congenial for the development of stem rot disease in mustard. Due to rise in maximum temperature in post-rainy(Rabi) season, and shortening of cold period of Powdery mildew (*Erysiphe crusifearum*) on oilseed brassica has been observed. Appearing earlier (December) than usual time (late January to February) (Chatopadhyay *et al*, 2012). All these conditions clearly indicate towards the need of integration of management. Tactics right before sowing to post harvesting of the crop.

Development and Implementation of IDM module in rapeseed-mustard

Agriculture Research Station(Navgaon) (Swami Keshwanand Rajasthan Agriculture University, Bikaner), in collaboration with National Council of Integrated Pest Management(NCIPM), New Delhi, conducted through research work on the occurrence and management of major diseases of rapeseed-mustard. Research conducted in the nation and elsewhere were also shuffled thoroughly, conjugated with the generated findings and an integrated disease management module was developed to combat major problems in rapeseed-mustard. In the later phase multilocational fields validation of the module was done on large scale for adaptive feasibility and economic profitability of technology, the details of the technologies integrated and the rationale thereof are presented in Table1.

Table1: Integrated Disease Management Module for rapeseed-mustard.

Crop stage	Recommended practice	Rationale
Pre-sowing	Removal of weeds and crop residue	Destruction of pests surviving in crop remains
	Summer deep ploughing	Destruction of soil insects and micro-organisms
Sowing time	Timely sowing of crop (10-12 Oct.)	Reduction in disease and pest severity
	Balanced use of fertilizers (NPK: 80,40,40 kg per ha.)	Increase pest resistance and productivity enhancement
	Proper seed rate (4 kg per ha)	Increased plant population increases severity of insects and diseases
	Seed treatment with Apron 35 SD (6 g/kg seed) or *Trichoderma* (10 g/kg seed) or garlic extract (2%)	Protection from seed and soil fungi
	Seed treatment with Imidacloprid 70 WS (7ml/kg)	Management of painted bug and other insects
	Use of improved/ certified seed variety	eg. Mustard var. RRN 505 is tolerant to frost injury and stem rot disease. Var. Aravali and RGN 73 are reported for frost tolerance
Post germination	Weed free bunds	Control of painted bug/ insects

	Dusting Malathion 5% or Methyl parathion 2% or Endosulphan 4% dust @ 25 kg/ha at 10 DAS	Control of painted bug/ insects
	Removal of host weeds	Removal of *Chenopodium* reduces *Alternaria* blight, removal of *Asphodilus* sp. Reduces stem rot disease
	Maintaining proper plant population	Dense crop favour increase in disease and insect severity
During branching	Use of pest control measures in early crops of radish, turnip and toria	Management of mustard saw fly
	Collection and destruction of saw fly population during dawn	Management of mustard saw fly
	Use of suggested measures for painted bug/ insects	Insect/ pest management
	Removal of disease infected lower leaves	Management of White rust and Downy mildew diseases
	Spray of Ridomil MZ 72 WP (2.5 g/ lit)	Disease management
	Spray of 2% leaf extract of Eucalyptus/ neem at symptom expression	Disease management
Flowering and pod formation	Spray of Ridomil/ mancozeb as suggested above	White rust and *Alternaria* blight management
	Spray of 2% garlic extract at symptom expression	White rust and *Alternaria* blight management
	Spray of Antracol (2 gm/littre)	Particularly for management of *Alterneria* blight
	Proper drainage and balanced humidity	Management of stem rot disease
	Spray of 0.5% carbendazim at 50% flowering	Management of stem rot disease
	Removal & destruction of stem rot affected plants.	Management of stem rot disease
	Adoption of proper crop rotation	Management of insect pests and diseases
	Removal of aphid affected inflorescence	Management of mustard aphid
	Spray of 5% Neem seed Kernel extract in water	Management of mustard aphid
	Spray of Malathion 50 EC or Dimethoate 30 EC or Oxymethyl-Demeton 25 EC or Endosulphan 35 EC (@ 1 littre/hac.) at below Economic Threshhold level (i.e. 25 aphids/10 central twig).	Management of mustard aphid (with special reference that Endosulphan 35 EC and Melathion 50 EC are less harmful to Honey-bees).
	Spray of 1 gm Karathene/littre or Dusting25 kg Sulphur/hac. during morning/evening time.	Management of Powdery mildew disease
	For late leaf minor spray oxy-methyl-demeton 25 EC (1 lit/ha.)	For the management of leaf minor

Methodology

Barley, wheat and mustard are the main *rabi* crops in zone IIIb of Rajasthan (Alwar) and the entire economic status of the cultivators are released through these crops. Bore wells are the main source of irrigation in the zone, whereas the zone is comprised of nine Agro-ecological situations. The average land holding of farmers is 2 to 4 hectares. The Integrated Pest Management Modules was validated at large on various farmers' fields Mohammadpur, Ramgarh, Behror and tinkiruri. Villages of Ramgarh, Behror and Mundawar, Tehsil of Alwar District. Economics cultivation was calculated with a randomly selected sample size of 70 non-IPM farmers' and compared with economic and technical parameters of IPM partial budget for analytical approach was prepared to access the economic feasibility of IPM module. The cost of input was considered as reported by the farmers and cross checked with prevailing market cost of inputs. The sale price of mustard was considered on the basis of minimum support price mustard for the year under trial and yield returns from IPM and non-IPM systems were converted in terms of rupees to calculate gross and net returns and the ratio of per rupees returns was estimated (Table2). The parameters considered for cost analysis were the human labour engaged, cost of mechanical output and the materials used for cultivation i.e. the seed, manure and fertilizers, plant protection measures applied an irrigation etc. Singh and Chandra (2004) also considered human labor, bullock and machine labor, seed, fertilizer and manure, insecticides, irrigation charges and interest on working capital as operational cost of inputs and rental value of owned land, rent paid for leased land, land revenue and taxes, depreciation on implements and farm buildings and interest on fixed capital as fixed cost for growth analysis of production and economic factors in rapeseed-mustard cultivation in India.

Result and Discussion

Summing up the parameters, the total cost variable incurred in IPM cultivation was Rs. 27730/= as compared to Rs. 24965/= in non-IPM cultivation. It includes the interest on working capital @ 12% per annum for the crop period (Six months). The present change over non-IPM cultivation was calculated to be +11.08 %, as per the returns, the gross return computed under IPM cultivation was RS. 63000/= against Rs. 44250/= under non-IPM per hectare indicating +42.00% change over non-IPM cultivation. Reducing the total cost of variables from the gross income, net returns from IPM cultivation was Rs. 33606/=. The per rupees returns was 1:2.14 under IPM cultivation, compared to 1:1.67 in non-IPM. The production cost in terms of rupees per Q calculated by the division of total variable cost with the harvested yield was Rs. 1633.00 against Rs. 2117.00 indicating that the increase in yield due to IPM intervention decreased the per quintal productivity cost of crop. Greater cost of plant protection measures is however, incurred in IPM (Rs. 90.55/q) against non-IPM (Rs. 77.6/q) indicating (+) 16.62 change over non-IPM.

Table 2 : Economics of IPM and non-IPM cultivation in mustard crop (on variable cost)

S.NO.	Items	Rupees per hectare		
A.	**Costs**	IPM cultivation	Non-IPM cultivation	% change over non-IPM
	1. Human labour	10500	9015	+16.47
	2. Machine labour	4050	3850	+5.19
	3. Materials used			
	(i) Seed	200	250	-20.0
	(ii) FYM	950	750	+26.66
	(iii) Fertilizer (N,P,K,S & Zn)	2000	1730	+15.66
	(iv) Plant protection chemicals			
	a. Trichoderma (seed treatment)	60	---	+100
	b. Mancozeb(2-spray)	600	600	- 00
	c. Methyl Demeton(one spray)	370	370	-00
	d. Melathion (one spray)	300	---	+100
	e. Karathene (one spray)	300	---	+100
	4. Irrigation(2) charge	3000	3000	00
	Sub total	27730	24965	11.08
	5. Interest on working capital (12%) for 6 months	1664	1498	11.08
	Total Variable cost	29394	26463	11.08
B.	**Returns**			
	Yield (q/ha) Grain	18	12.50	44
	Straw	40	30.00	33
	Price of Grain Rs. 3000/= per q(MSP) Price of Straw Rs. 225/= per q(local rate)			
	Gross Returns	63000	44250	42
	Net Returns	33606	17783	88.98
	Per Rupees Returns	1:2.14	1:1.67	
C.	Cost of production under IPM and non-IPM cultivation of mustard crop			
	Total variable cost/q	1633.00	2117.04	-28.75
	Cost of plant protection input	90.55	77.60	+16.62

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