THE RESEARCH STATUS OF CROP PROTECTION TECHNOLOGIES USED TO ACHIEVE HIGH PRAPESEED-MUSTARD YIELDS IN INDIA

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ABSTRACT

Rapeseed-mustard holds about 27.5% of total oilseed production and 13% of the total grossed cropped area in India but yields could be obtained as low as around 940 kg ha^{-1}. The potential yield could be over 2500 kg ha^{-1} but the same could not be realized on farmer's field because of one of such important crop production constraints as diseases; viz., Alternaria blight and white rust + downy mildew complex, which account to a yield loss of about 10-70% depending on the prevailing weather conditions favourable for development of these diseases. This paper deals with the status of research on plant protection technologies particularly the integrated disease management (IDM) strategy used to achieve high rapeseed-mustard yields in India. The present plan of plant protection technology (induced host resistance and AB management strategy by gene pyramiding) are also briefly discussed.

KEYWORDS: Plant protection, diseases, higher yield, rapeseed-mustard.

INTRODUCTION

Rapeseed-mustard is the most important edible oilseed crop in northern parts of India. It holds about 27.5% of the total oilseed production and 13% of the grossed cropped area in India. The low level of productivity in India (< 940 kg ha^{-1}) is largely because the crop is rainfed exposed to various biotic and abiotic stresses and also due to socio-economic factors associated with small and marginal farmers in the rainfed and dry land areas **(Rai *et al.*, 2002)**. The status of research on crop protection technologies used to achieve higher rapeseed-mustard yields under the above situations are presented in this paper.

MATERIALS AND METHODS

For development of high yielding varieties with multiple resistance/tolerance to foliar pathogens, large number of genotypes were screened at the seedling stage in the greenhouse using standard inoculation techniques **(Vishwanath and Kolte, 1999)** and by using an infector-row technique in the field. For plant protection package treatments (P_1P_1), the experimental field at the Crop Research Centre, GBPUAT, Pantnagar was used. Mustard varieties Varuna (V_1) and Kranti (V_2) in two dates of sowing 20 October (S_1) and 20 November (S_2) were planted in standard experimental plots using randomized block design with three replications. The treatments without any chemical

seed treatment and/or fungicide sprays served as check (P_0P_0) in each sowing date with respect to each of the two varieties used. The seeds under P_1P_1 treatments were treated with metalaxyl @ 6 g kg^{-1} of seed and plants raised from such treated seeds were further sprayed with Ridomil MZ @ 0.25% spray at 50 days after sowing (DAS) followed by mancozeb @ 0.2% at 70 and 90 DAS.

Observations on white rust (WR), Alternaria blight (AB) severity, 1000-seed weight and yield data were taken and the data were analysed statistically and significance of treatment means was followed at P = 0.05.

RESULTS AND DISCUSSION

Some of the most promising genotypes which were found to be highly tolerant to AB (*A. brassicae*) in *B. juncea* are : PAB 9538, PAB 9511, PAB 9534, RGN-11 and Divya Selection 2; and to WR (*A. candida*) are : PWR 9541 and PWR 9542, PAB 9841, JMWR 92-1, and EC 399301.

The integrated disease management (IDM) module consisting of P_1P_1 treatment in each sowing date and in both the varieties revealed that the use of these technologies involving timely sowing (20 October), recommended plant spacing (30–45 × 10–15 cm), balanced fertilizer application (N_{100}, P_{40}, K_{40}), timely thinning (21 DAS) and spraying the crop first with Ridomil @ 0.25% at pre-flowering stage followed by two sprays of mancozeb at post-flowering-cum-pod formation stages could result in significant control of AB and WR diseases reflecting in yield advantage varying from 28.58 to 560.0% over P_0P_0 (check) treatments (Table 1).

The present research priorities are confined to (i) understanding of infection-rate reducing resistance to *A. brassicae* and its use in development of viable disease management strategy by following the gene pyramiding concept, (ii) development of short-statured, early maturing, high harvest index (> 29%) Alternaria tolerant mustard strains, and (iii) studying a new approach of using biotic (avirulent strain and / or non-pathogens) and abiotic (BTH and SA) elicitors in induction of resistance to multiple diseases.

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Table 1: Integrated disease management module and its significance in achieving higher yield of mustard in India

Treatment	WR index on leaf (Arcsine values)		WR staghead (Arcsine values)	AB index on leaf (Arcsine values)		AB index on pod (Arcsine values)		1000-seed weight (g)		Yield (kg ha^{-1})		Increase in yield due to P_1P_1 over P_0P_0 (%)	
	Y_1	Y_2	Y_1	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
$S_1V_1\ P_0P_0$	36.92	39.2	6.30	50.78	56.0	53.73	50.8	3.47	3.85	937.0	1741.0	–	
$S_1V_1\ P_1P_1$	28.22	33.2	5.18	39.21	46.4	50.77	45.0	4.11	3.90	1901.0	2720.0	102.8	56.20
$S_1V_2\ P_0P_0$	37.73	39.2	5.21	51.50	56.8	54.49	47.9	3.60	2.80	1093.0	416.0	–	
$S_1V_2\ P_1P_1$	25.39	33.2	1.89	38.49	49.3	50.04	45.0	3.97	3.71	1890.0	2746.0	72.9	560.00
$S_2V_1\ P_0P_0$	39.23	40.0	44.66	56.79	56.8	39.96	47.9	3.18	2.80	409.0	416.0	–	
$S_2V_1\ P_1P_1$	40.68	39.2	18.82	51.51	50.8	35.48	45.0	3.55	3.00	1197.0	685.4	192.0	64.662
$S_2V_2\ P_0P_0$	39.96	39.2	47.75	56.79	56.8	42.12	50.8	3.22	2.79	305.0	637.5	–	
$S_2V_2\ P_1P_1$	39.23	39.2	21.09	50.78	50.8	38.45	39.2	3.41	3.13	1067.0	891.7	249.0	28.58
CD at 5%	4.15	0.75	8.80	1.86	1.68	2.47	0.40	0.41	0.33	389.5	293.7		

WR = White rust; AB = Alternaria blight; S_1 = sowing date 20 October; S_2 = 20 November; Y_1 = 1999-2000; Y_2 = 2000-2001; P_0P_0 = No plant protection chemical treatment; P_1P_1 = recommended plant protection practices i.e. NPK = 100 : 40 : 40 kg ha^{-1}; Seed treatment with metalaxyl @ 6 g kg^{-1} seed; Ridomil MZ @ 0.25% spray at 50 DAS followed by mancozeb spray @ 0.2% at 70 and 90 DAS.