

Performance of mustard variety NRCHB-101 through cluster frontline demonstration in Malda, West Bengal

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Mustard variety NRCHB-101 was introduced in adopted villages of Malda Krishi Vigyan Kendra, West Bengal under Cluster Frontline Demonstration on Oilseeds of National Food Security Mission in 110 ha land area during rabi 2019-20. This variety along with appropriate IPM module from the initial stage of cultivation was found superior over the farmer grown varieties with farmers' practice and gave seed yield of 16.13 q/ha and straw yield of 5.38 q/ha under irrigated condition which was higher over local by 63.57%. This hybrid recorded additional net return and B:C ratio of ₹46,679/ha and 2.10, respectively over locally grown cultivar. Owing to good level of protection from insect and diseases, high yield and high quality parameters, NRCHB-101 with improved IPM package is a suitable choice from farmers' perspective and the IPM module also maintained soil fertility satisfactorily under old alluvial soil of Malda district of West Bengal.

Keywords: Cluster frontline demonstration, Integrated pest management, Mustard, National food security mission, NRCHB-101

PRODUCTIVITY of mustard was 10.9 q/ha in West Bengal with an area of 4.58 lakh ha and production of 4.99 lakh tonnes during 2015-16. The main causes for low production of mustard are large acreage under marginal land, which is deficient in major nutrients and imbalanced nutrient management and insect-pests. Among various insects, aphid solely causes 35.4 to 73.3% yield loss, 30.09% seed weight loss and 2.75% oil loss. In India up to 71% yield loss has been reported due to *Alternaria*, up to 27 and 89.90% during leaf and stag-head phases, respectively due to white rust and up to 100% due to *Sclerotinia* stem rot. The main objective of Cluster Frontline Demonstration (CFLD) under National Food Security Mission (NFSM) is to introduce new variety along with improved Integrated Pest Management (IPM) module. The use of chemicals for insects and diseases control leads to problems such as environmental

pollution, development of resistance to pesticides, harmful effects on non-target organisms including pollinators, pest resurgence, upsetting the balance of nature and threat to the health of man. Therefore, the present investigation was undertaken to study the impact of new variety with appropriate module of IPM i.e. seed treatment, soil treatment, herbicidal spray, water management, less and timely spraying of sulphur and micronutrient and need based sprayings of new insecticides and fungicides at various stages of crop on yield, yield components and morphological characters to enhance the productivity of mustard which offers immense scope for further yield enhancement and to attain the self-sufficiency in edible oils.

Package of practices

Site description: CFLD was carried out at 275 farmers' fields of Krishi Vigyan Kendra (KVK) adopted villages of Ratua-I, Ratua-II,

Chanchal-I, Chanchal-II, Harischandrapur-I and Manikchak blocks of Malda district, West Bengal under irrigated non-limiting soil moisture conditions in humid climate of eastern plains zone in India during rabi 2019-20. The soil of experimental fields was sandy loam-clay loam in texture.

Sowing time: Optimum time for sowing of Indian mustard is in between 15 October to 15 November to avoid mustard aphid infestation (Fig. 1). Keeping this factor in mind, NRCHB-101 variety of mustard was sown @ 7.5 kg/ha within 15th October – 25th October, 2019. Early sowing may be ascribed to good plant vigour due to favourable climatic conditions throughout the crop life cycle. Besides, early sowing also mismatch the most susceptible crop stage and peak period of aphid infestation, resulting in lower biotic interference as it was recorded that aphid infestation started within 2nd-3rd



Fig. 1. Stages of growth of mustard NRCHB-101 under CFLD at Malda KVK

week of December and the crop had completed the flowering stage in the mid of January and plants became harder at pod formation stage before increase in the aphid population. Early sowing also reduces the incidence of fungal diseases because moist (more than 70% relative humidity) coupled with warm weather (12-25 °C) and intermittent rains favour this fungal diseases development.

Sowing of seeds: Seeds were treated with Carbendazim 50% WS @ 2 g/kg of seed one day before sowing of seeds. Sowing was done in rows with spacing of 30 cm × 15 cm. Spacing was maintained by thinning of extra plants at 20 days after sowing. Carbendazim is a systemic fungicide and supposed to be more stable in soil and ensures continuous supply of fungicide to the above ground part of the plant. As a benzimidazole group of fungicide, it is converted on the plant surface to benzimidazole

carbamate which interferes with nuclear division of sensitive fungi. A secondary effect of this fungicide is better growth of the plants during early stages perhaps by changing host metabolism or through some change in availability of nutrients from soil. Seed treatment reduces the incidence of soil borne pathogens particularly *Sclerotinia* stem rot in mustard.

Soil treatment: Soil treatment was done with well rotten cow-dung manure @ 375 kg/ha and *Trichoderma viridae* @ 1.5 kg/ha and *Pseudomonas fluorescence* @ 1.5 kg/ha at the time of final land preparation. The mixture of cow-dung manure and bio-pesticides was done 15 days before the final land preparation and applied to the soil of field 7 days before sowing of seeds. It was reported that the use of organic manures alone or in combination with chemical fertilizers, helps in improving physico-chemical

properties of the soil and improves the efficient utilization of applied fertilizers resulting in higher seed yield and quality. Further, it stimulates the activity of micro-organisms that makes the plant to get the macro and micronutrients through enhanced biological processes, and increased nutrient solubility. Moreover, the bio-fungicides help in reducing the incidence of white rust and *Sclerotinia* rot which occurs mostly during October-November

Application of fertilizer and micro-nutrients

Normal agronomical practices with the recommended doses of NPK (60:40:40 kg NPK/ha) were applied at the time of sowing. A basal half dose of nitrogen and full dosages of other fertilizers, viz. P_2O_5 and K_2O were incorporated into the soil before sowing the crop and remaining half dose of nitrogen was top dressed after

the 1st irrigation. Boron 20% @ 1 g/L and Zinc @ 2 g/L were sprayed at 30-35 DAS with sticker @ 0.5 ml/L and Sulphur was sprayed @ 3 gm/L at 40-45 DAS. Sulphur exerted beneficial influence on the health of Brassicaceae plants by increasing the nitrogen uptake in seed and stover to stimulate protein synthesis, oil content and its synergistic effect on utilization of nitrogen by mustard plant. The application of macro and micronutrients also enhances the tolerance level of mustard crop against *Alternaria* blight and white rust diseases and enables the plants to escape the pathogen infection at the most susceptible stage and induces increasing nutrient concentration in biological produce (seed and stover) due to synergistic effect for added supply of nutrients and well developed root system under balanced nutrient application resulting in higher absorption of nutrient, water and better disease protection.

Weed management

Herbicide application was done with Ammonium salt of Glyphosate @ 2.5 kg/ha as preventive measure before 10-15 days of sowing of seeds to control *Chenopodium album*, *Phalaris minor* of the previous crop. As a broad spectrum systemic herbicide and crop desiccant, it acts by inhibiting the plant enzyme involved in the synthesis of amino acids and kills annual broad leaf weeds and grasses. It is absorbed through foliage and minimally through roots and transported to growing points of plant. While growth stops within hours of application, it takes several days for the leaves to begin turning yellow. It was reported that uniformly dried crops do not have to be windrowed prior to harvest but can easily be straight-cut and harvested due to application of glyphosate. The spatial extent of ground and surface water pollution is considered to be relatively limited due to sorption of glyphosate onto soil minerals. It is readily degraded by soil microbes. Besides this, one manual weeding at 30-35 DAS was also done to control weeds effectively.

Water management

Generally farmers are not eager to irrigate mustard crop anymore. But the crop responds to irrigation, particularly around 35 DAS during vegetative stage and at the early pod filling stage (around 65 DAS). These two irrigations stages are very beneficial for proper vegetative and reproductive growth of mustard.

Plant protection measures

Insect management: The major insects of mustard are mustard aphid, saw fly, painted bug, leaf miner and tobacco caterpillar. Tobacco caterpillar and painted bug infest mustard at seedling stage to early vegetative stage during October-November. Spinosad 45% SC @ 225 ml/ha and Acephate 50% + Imidacloprid 1.8% @ 900 g/ha were sprayed for these two insects, respectively at 30-35 and 35-40 DAS. Spinosad is a fermented product of soil actinomycetis, has rapid contact and ingestion activities. Acephate is a systemic organophosphate foliar insecticide used to control sucking and biting insects by direct contact or ingestion. Imidacloprid, a neonicotinoid group of systemic insecticide, affects on the nervous system of insects. Application of Chlorfenapyr 10% SC @ 450 ml/ha is done at 60-65 DAS against mustard saw fly which attacks during October-December at vegetative stage. Chlorfenapyr is a pyrrole insecticide and acaricides with dual function of stomach poison and contact insecticide. Mustard aphid attacks mustard at vegetative, flowering and pod formation stage during December-March. But only one spraying was done against aphid at 85-90 DAS with Acetamiprid 20% SP @ 225 g/ha as early sowing minimizes the chance of aphid. Acetamiprid is also a neo-nicotinoid having action on synaptic junction of insect nervous system. Insecticides do not have any residual toxicity, phytotoxicity, resistance to insects and cross resistance to other insect control agents. All the spraying of insecticides were done as curative measure with sticker @ 225 ml/ha. Installation of Yellow Sticky Trap @ 15 traps/ acre was done at 10-15 days

before flowering for aphid and other sucking insects and it continued up to the maturity of the crop.

Disease management: Among the diseases of mustard, *Alternaria* leaf blight, white rust and *Sclerotinia* stem rot are very important. White rust and *Sclerotinia* rot occurs both at vegetative and reproductive stages from October-November to February-March, whereas *Alternaria* blight infests throughout the crop growth mainly during February-March. So, metalaxyl 8% + mancozeb 64% WP @ 1.125 kg/ha and propiconazole 25% EC @ 450 ml/ha were applied with sticker @ 225 ml/ha first during 35-40 DAS and second during 85-90 DAS at initiation of pod formation stage. All the sprayings of fungicides were done as preventive measure. Mancozeb is derivative of dithiocarbamic acid of sulphur fungicide which is very effective against fungal diseases. Metalaxyl is also a systemic fungicide like carbendazim and has curative effect and eradicates infection from treated plant. It is readily translocated from roots to aerial parts of plant and persists for several months in soil. As secondary effect, it induces a mild shift in host plant resistance expression. The systemic fungicides are absorbed by the host plant, translocated internally through before and after infection. Carbendazim (Benzimidazole) interferes with nuclear division by binding to protein subunits of the spindle microtubules. Metalaxyl affects ribosomal RNA of the fungi and interferes with protein synthesis. Propiconazole is a triazole group of systemic fungicide which shows a long term protective and curative activity against white rust and *Alternaria* leaf blight, thus facilitating lesser number of applications and longer intervals between sprays. It is a sterol inhibiting fungicide which inhibits ergosterol (a cellular compound that plays a crucial role in structure and function of the membrane of fungi) biosynthesis. The lower older four leaves were destroyed i.e. defoliation were done at 60 DAS to control the *Alternaria* blight. It was recorded that removal of 50% lower leaves at 60 DAS reduces the secondary spread

of the diseases and increase yield of mustard.

Impact on growth and yield attributes

The mustard variety NRCHB-101 matured, on an average, in 110 days and took 65-70 days to flower. It exhibited high tillering with on an average 8.4 branches/ plant, 101.2 siliqua/ plant, 18.6 seeds/ siliqua and reddish colour. The variety attained the height of approximately 113.8 cm and produced pods 6.02 cm long and 1.3 cm thick. On the other hand, farmer's technology with local variety (sown during 3rd week of November to 1st week of December) and no seed treatment, soil treatment, no irrigation, excess use of fertilizer, improper herbicide and insecticide and fungicide spray at inappropriate dose and time showed medium tillering with on an average 4.2 branches/ plant, 79 siliqua/ plant, 11.2 seeds/ siliqua and attained 77.01 cm height, 4.51 cm pod length and 1.3 cm pod thickness (Table 1). It was recorded that highest number of primary branches/plant, secondary branches/plant, plant height, number of siliqua/plant, siliqua weight/plant and number of seeds/siliqua signified the coherence of integrated insect and disease management practices for reduction of various diseases and enhanced plant growth. This was in conformity with the present investigation.

Impact on yield and yield components

The mustard variety NRCHB-101 was found superior over the farmers grown varieties and gave seed yield of 16.13 q/ha and straw yield 5.38 q/ha which were higher over locally grown cultivar by 63.57%, whereas seed yield and straw yield were recorded as 9.86 q/ha and 3.29 q/ha, respectively in farmers grown variety (Table 2). Similarly, test weight of NRCHB-101 (6.63 g) was also higher than local (3.7 g). The avoidable yield was recorded 38.68% as depicted in Table 2. This result was positively correlated with the findings of growth and yield attributes of mustard variety NRCHB-101. Considerable experimental evidences are available on usefulness of cultural and agronomic practices such as

Table 1. Performance of Mustard var. NRCHB-101 with IPM components on growth and yield attributes

Technology	Plant height (cm)	No of branches/ plant	No of siliqua/ plant	No of seeds/ siliqua	Pod length (cm)	Pod thickness (cm)
Mustard var. NRCHB-101 + IPM	113.79	8.4	101.2	18.6	6.02	1.3
Local mustard variety + Farmers' practice	77.01	4.2	79	11.2	4.51	0.9

Table 2. Performance of Mustard var. NRCHB-101 with IPM components on test weight, straw yield, grain yield

Technology	Test weight (g)	Straw yield (q/ ha)	Increased straw % yield	Seed Yield q/ha	Increased % seed yield	Avoidable yield loss (%)
Mustard var. NRCHB-101 + IPM	6.63	5.38	63.57	16.13	63.57	38.68
Local mustard variety + Farmers' practice	3.7	3.29	-	9.86	-	-

sanitation, spacing and nutrient management in minimizing the yield loss due to diseases and pests. Brassicaceae has a high sulphur demand, while fair responses for disease resistance, yield and oil contents have also been reported with zinc, sulphur and boron applications. It was also revealed that the application of zinc, boron and sulphur increased the mustard seed yield by 12, 21 and 25%, respectively. Combined application of micro and secondary nutrients (Zn, B and S) along with NPK as balanced fertilization with integrated treatments enhanced the fertilizer use

efficiency over farmers practice with local variety.

Impact on economics of cultivation

Table 3 and 4 denote economics of mustard variety NRCHB-101 in comparison with local variety used by farmers. Under irrigated condition farmers were getting average gross return of ₹ 64,513/ha along with net return of ₹ 46,679/ha which was higher than local cultivar with ₹ 35,278/ha and net return of ₹ 18,331/ha. The B:C ratio of NRCHB-101 (2.10) was also higher than local cultivar (0.83). These findings were due to higher growth

Table 3. Cost of cultivation in demonstration and farmers' plot

Particular	Cost of demonstration plot/ha (₹)	Cost of farmers' plot/ha (₹)
Seed	1,125	600
Land preparation	2,540	2,480
Fertilizer	3,750	4,210
Irrigation	3,670	560
Plant protection chemicals	7,163	9,430
Labour cost for seed sowing, land preparation, fertilizer application, irrigation, spraying, weeding, harvesting and threshing	4,652	4,792
Total	22,900	22,072

Table 4. Performance of Mustard var. NRCHB-101 with IPM components on economics of cultivation of mustard

Technology	Average cost of cultivation (₹/ha)	Average gross return (₹/ha)	Average net return (₹/ha)	B:C ratio
Mustard var. NRCHB-101 + IPM	22,900	64,513	46,679	2.10
Local mustard variety + Farmers' practice	22,072	35,278	18,331	0.83

and yield attributes as well as seed yield, straw yield and test weight of mustard variety NRCHB-101 because of integrated treatments of cultural, mechanical and chemical management of insect and disease at proper dose and time with appropriate dose of macro and micronutrients.

SUMMARY

NRCHB-101 is suitable for irrigated, timely sown condition of Old Alluvial Zone of Malda, West Bengal. The variety revealed superior performances over the farmers'

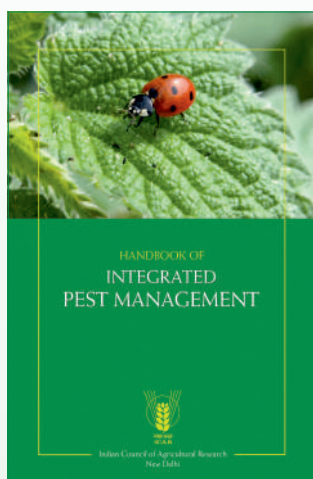
grown varieties in terms of growth, yield attributes, seed yield, straw yield, test weight and economics of cultivation of mustard. Moreover, this variety also showed good level of protection against mustard aphid, saw fly, painted bug, leaf miner, *Alternaria* leaf blight, white rust and *Sclerotinia* stem rot (which are the main constraints in mustard cultivation) with appropriate IPM module. Owing to high yield and high quality parameters, NRCHB-101 is a suitable choice from farmers' perspective. The productivity achieved under CFLD over farmers

practices created awareness and motivated other farmers in cultivation of NRCHB-101 variety of mustard and also to adopt critical innovations for mustard cultivation viz. seed treatment, soil treatment, herbicide spray, water management, macro and micro nutrients, integrated pest management and other technology of mustard in the district.

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HANDBOOK OF INTEGRATED PEST MANAGEMENT

To reverse the loss of environmental resources and also to reduce biodiversity loss, the Government of India has Integrated Pest Management (IPM) as part of the National Agricultural Policy. Integrated Pest Management emphasizes the growth of a health crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms. IPM is not new – mechanical, cultural and biological tactics were used by farmers for hundreds of years before chemical pesticides became available. Besides, there are IPM techniques that have been developed more recently and are effective in suppressing pests without adversely affecting the environment.



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TECHNICAL SPECIFICATIONS

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