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Research Paper

A REVIEW ON BRASSICA JUNCEA: INDIAN MUSTARD

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Abstract

India is the fourth largest oilseed economy in the world after USA, China and Brazil. There are seven edible oilseeds cultivated in India and among them rapeseed-mustard contributes approx. 30 % in the total oilseeds production and ranks second after groundnut sharing 27.8% in the India's oilseed economy. There is vast diversity in the agro climatic conditions in India and different species of rapeseed-mustard are grown in some or the other part of the country. There is a big gap between requirement and production of mustard in India mainly because of the poor socio-economic condition of Indian farmers engaged in the cultivation of Indian Mustard. The need of the hour is effective management of natural resources, integrated approach to plant-water, nutrient and pest management and extension of rapeseed-mustard cultivation to newer areas under different cropping systems.This will increase and stabilize the productivity and production of Indian mustard. This paper reviews about the advancements in proper land and seedbed preparation, optimum seed and sowing, planting technique, crop geometry, plant canopy, appropriate cropping system, integrated nutrient management to meet the ever growing demand of oil in the country and to achieve the goal of production of 24 million tons of oilseed by 2020 AD.

Key Words: Brassica juncea, Indian mustard, rapeseed

Introduction

After soybean (Glycine max) and palm (Elaeisguineensis) rapeseed-mustard is the third important oilseed crop in the world. Rapeseed-mustard (Brassica spp.) contributes 28.6% in the total production of oilseeds in India among the seven edible oilseeds cultivated here. In India, it is the second most important edible oilseed after groundnut sharing 27.8% in the India's oilseed economy. India contributes 28.3% and 19.8% in world acreage and production. India produces around 6.7 mt of rapeseed-mustard next to China (11-12 mt) and EU (10–13 mt) with significant contribution in world rapeseed-mustard industry. The rapeseed-mustard group broadly includes Indian mustard, yellow sarson, brown sarson, raya, and toria crops. In states like Rajasthan, UP, Haryana, Madhya Pradesh, and GujaratIndian mustard (Brassica juncea) is predominantly cultivated and is also grown under some nontraditional areas of South India including Karnataka, Tamil Nadu, and Andhra Pradesh. The crop can be easily raised under irrigated as well as rain fed conditions. Brown sarson (B. rapasspsarson) has 2 ecotypes lotni and toria. Yellow sarson (B. rapa var. trilocularis) is predominantly cultivated in Assam, Bihar, Orissa, and West Bengal as rabi crop. In Punjab, Haryana, UP, Himachal Pradesh, and Madhya Pradesh, it is grown mainly as a catch crop. There are new emerging oilseed crops but having limited area of cultivation likeGobhi sarson (B. napusssp. oleferiavar annua) and karanrai (Brassica carinata). Gobhi sarson is a long duration crop confined to Haryana, Punjab, and Himachal Pradesh. It has good yield potential, wide adaptability and possesses high oil content of good quality whereas karanrai yields well and shows better environment adoption and substantial resistance to pests and diseases.

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Mostly mustard is cultivated under temperate climates. However it is also grown in certain tropical and subtropical regions as a cold weather crop. Indian mustard is reported to tolerate annual precipitation of 500 to 4200 mm, annual temperature of 6 to 27°C, and pH of 4.3 to 8.3. Rapeseed-mustard follows C3 pathway for carbon assimilation. Therefore, it has efficient photosynthetic response at 15–20°C temperature. At this temperature the plant achieve maximum CO_2 exchange range which declines thereafter.

Rai is mostly grown as a rainfed crop, preferring a pH from 5.5 to 6.8, thrives in areas with hot days and cool night and can fairly sustain drought. Mustard requires well-drained sandy loam soil. Rapeseed-mustard has a low water requirement (240–400 mm) which fits well in the rainfed cropping systems. Nearly 20% area under these crops is rainfed.

Distribution and Adaptation of Crop in India

The rapeseed-mustard group includes brown sarson, raya, and toria crops. Indian mustard (Brassica juncea) is predominantly cultivated in the states of Rajasthan, UP, Haryana, Madhya Pradesh, and Gujarat and is also grown under some nontraditional areas of South India including Karnataka, Tamil Nadu, and Andhra Pradesh. The crop can be easily raised under irrigated as well as rainfed conditions. However, being more responsive to fertilizers, it gives better return under irrigated condition.

Brown sarson (B. rapa ssp. sarson) has 2 ecotypes lotni and toria and Yellow sarson (B. rapavar. trilocularis) is cultivated in Assam, Bihar, Orissa, and West Bengal as rabi crop, whereas in Punjab, Haryana, UP, Himachal Pradesh, and Madhya Pradesh, it is grown mainly as a catch crop.

Taramira (Eruca sativa) is grown in the drier parts of North-West India comprising the states of Rajasthan, Haryana and UP.

Gobhi sarson (B. napus ssp. oleferia Var. annua) and karanrai (Brassica carinata) are the new emerging oilseed crops having limited area of cultivation. Gobhi sarson is a long duration crop confined to Haryana, Punjab, and Himachal Pradesh. It is photo- and thermo sensitive and makes little growth up to middle of February, but in the end of this month, plants make a quick growth. It has good yield potential, wide adaptability, and possesses high oil content of good quality[1].

Varietals Development

As, there is a vast variability in the climatic and edaphic conditions in the mustard growing areas of India, the selection of appropriate cultivars is very important as it helps in increasing the productivity. Introduction of relatively short duration cultivar found favor with the environment where effective growing seasonal length is short. Improved varieties of mustard,on one hand, stabilizes oil and seed yield through insulation of cultivars against major biotic and abiotic stresses while on the other hand it enhances oil (low erucic acid) and seed meal (low glucosinolate) quality.

The first Indian mustard hybrid, named “NRCHB-506,” has been developed at Directorate of Rapeseed-Mustard Research, Bharatpur which can catapult the output of the country’s key oil crop. The new hybrid is meant for cultivation in Rajasthan and Uttar Pradesh. Other high yielding varieties include “JM-1”, “JM-3”, “Pusa Bold”, “NRCDR-2” and “NRCDR 601”. Their yield potentials vary from 16 to 25 q/ha.

At IARI, an early-maturing and bold seeded mustard variety has been developed called “Mehak” (B. juncea). This improved variety is suitable for early sowing to replace toria (B. rapa var. toria) in Delhi and adjoining areas. Gobhi sarson has a good yield potential, wide adaptability and possesses high oil content of good quality.

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"Hyola" (PAC-401) is canola type hybrid rapeseed, developed in India by Advanta India Ltd, Holland-based multinational company. "Neelam" (HPN-3) and "Sheetal" (HPN-1) are the popular varieties of gobhi sarson[2]. Since inception of mustard research programme in India, number of tolerant varieties to various abiotic and biotic stresses of rapeseed-mustard has been developed.

"PusaJaikisan" of B. juncea is the first variety though tissue culture. "TL-15" a toria variety has been recommended as summer crop for high altitude of Himachal Pradesh. In an attempt to incorporate resistance/tolerance to biotic and abiotic stresses in high yielding varieties, aphid tolerant strains like "RH-7846" "RH-7847" "RH-9020" and "RWAR-842" Alternaria blight moderately resistant variety "Saurabh"; white rust resistant variety, "Jawahar Mustard-1"; salt tolerant varieties "NarendraRai" and "CS-52" frost tolerant "RH-781" and "RH-7361" varieties have been identified. "RH-781" is also drought tolerant and suitable for intercropping. For nontraditional areas, Indian mustard varieties "Rajat", "PusaJaikisan" and "Sej.2" have been recommended.

Preparation of Land and Seedbed

A mustard seedbed should be firm, moist, and uniform which allows good seed-to-soil contact, planting depth (of approx. 5-7 cm deep) and quick moisture absorption leading to a uniform germination. Tillage affects both crop growth and grain yield. The various tillage systems are as follows: conventional tillage includes moldboard ploughing followed by disc harrowing; reduced tillage includes disc ploughing followed by disc harrowing and complete zero tillage in which crop is sown under uncultivated soil. Minimum tillage, with or without straw, enhances soil moisture conservation and moisture availability during crop growth. As a consequence, the root mass, yield components and seed yield increase [3]. Zero tillage is preferred in mustard as it conserves more moisture in the soil profile during early growth period. Subsequent release of conserved soil moisture regulates proper plant water status, soil temperature, lower soil mechanical resistance, leading to better root growth and higher grain yield of mustard [4]. Success with minimum or zero tillage requires even distribution of crop residues, as a well-designed crop rotation and evenly distributing residue will create a firm, moist and uniform seedbed.

Seed and Sowing

Vigorous seedling growth, good root development, early stem elongation, rapid ground covering ability, early flowering and radiation are important yield determining traits under low temperature and radiation regime. These traits can be successfully exploited in mustard if a good seed is grown at appropriate time along with maintaining an optimum plant population.

Seed treatment is a useful practice for healthy plant growth. Seed priming through controlled hydration and dehydration enhances early germination of mustard seed in less time, even in compacted soil [5]. The soaking of mustard seeds in 0.025% aqueous pyridoxine hydrochloride solution for 4 hours improved germination. The differential response of varieties for imbibition gives advantage to some of them to germinate early as compared to others.

Sowing time is the most vital nonmonetary input to achieve target yields in mustard. Production efficiency of different genotypes greatly differs under different planting dates. Soil temperature and moisture influence the sowing time of rapeseed-mustard in various zones of the country. Sowing time influences phenological development of crop plants through temperature and heat unit. Sowing at optimum time gives higher yields due to suitable environment that prevails at all the

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growth stages. Though different varieties have a differential response to date of sowing, mustard sown on 14 and 21 October took significantly more days to 50% flowering (55 and 57) and maturity (154 and 156) compared to October 7 planting [6]. Delayed sowing resulted in poor growth, low yield, and oil content.Date of sowing influence the incidence of insect-pest and disease also. Mustard aphid (Lipaphiserysimi) has been reported as one of the most devastating pests in realizing the potential productivity of Indian mustard. Normal sowing (1st week of November) also helps in reducing the risk of mustard aphid incidence.

Sowing technique depends upon land resources, soil condition, and level of management and thus broadcast, line sowing, ridge and furrow method and broad bed and furrow method are common sowing techniques. At higher soil moisture regimes, broadcasting followed by light planking gives early emergence and growth. Under normal and conserved moisture regime, seed placement in moist horizon under line sowing becomes beneficial.

Paira or utera is a method of cropping in which the sowing of next crop is done in the standing previous crop without any tillage operation. Mustard sowing under paira/utera in the rice field has shown its edge over line sowing and broadcasting (Sowing of seeds by broad casting the seeds in the field) in eastern parts of India.

Ridge and furrow sowing was superior to conventional flat sowing for growth parameters and yield of Brassica juncea [7].

The competitive ability of a rapeseed-mustard plant depends greatly upon the density of plants per unit area and soil fertility status. The optimum plant population density/unit area varies with the environment, the genotype, the seeding time, and the season. Uniform distribution of crop plants over an area results in efficient use of nutrients, moisture, and suppression of weeds leading to high yield. In wider row spacing, solar radiation falling within the rows gets wasted particularly during the early stages of crop growth whereas in closer row spacing upper part of the crop canopy may be well above the light saturation capacity but the lower leaves remain starved of light and contribute negatively towards yield.

Conclusion

To meet the constantly growing demand of oil in the countryand the gap thus produced is to be bridged through management techniques. The tremendous increase in oilseed production is a result of development of high yielding varieties coupled with improved production technology, their widespread adoption and good support price. The vertical growth in mustard production can be brought by exploiting the available genetic resources with breeding and biotechnological tools which will break the yield barriers. Horizontal growth in rapeseed-mustard can be brought in those rapeseed-mustard growing areas/districts of the country, wherever, the yield is lower than the national average. Production technologies for different agroecological cropping systems, crop growing situations like intercropping, salinity, rainfall, and so forth, under unutilized farm situations like rice-fallows, mustard to be followed after cotton, sugarcane, soyabean, and so forth, and mustard as a paira crop in rice with lathyrus, lentil or any other competing rabi crop in traditional and nontraditional areas, need to be worked out. It is estimated that at least 1 million hectares can be brought under cultivation, through adoption of such cropping systems.

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