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Challenge of edible oils: Can Brassicas deliver?

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I am delighted to be here this morning amongst the distinguished gathering of scientists, students, planners, policy-makers, farmers and media persons, participating in the 2nd National Brassica Conference-2014 on "*Brassicas for Addressing Edible oils and Nutritional Security*", jointly organized by the Society for Rapeseed-Mustard Research and Punjab Agricultural University at Ludhiana internationally known as a hub of hosiery industry. At the outset, let me congratulate all the participants and organizers for organizing this national conference.

You are all aware that agriculture sector plays a very important role in India's social security and overall economic welfare. Oilseeds crops are the second most important determinant of agricultural economy, next only to cereals. India is the largest producer of oilseeds in the world and accounts for about 14 per cent of the global oilseeds area, 7 % of the total vegetable oils production, and 10 % of the total edible oils consumption. In India, oilseeds accounts for 3% to the Growth National Products and 10% to the total value of all agricultural products, and employs 14 and 1 million people respectively in oilseed cultivation and processing. In 2012-13, the total oilseed cultivated area, the total oilseed seed production and the total edible oil production, under the nine oilseeds crops, respectively, were 27 million ha, 29 million matric tones (mmt) and 7.45 mmt. Presently, India's annual edible oil consumption is about 17.5 mmt, which in the last decades has increased steadily at a compounded annual growth rate of 4.6%. The growth in per capita consumption is attributable to both rising income levels and living standards. However, the current per capita consumption of 14.3 kg/year in 2012-13 in India is considerably lower than the global average of 24 kg/year. In 2012-13, the major edible oils consumed in the country are palm oil, soybean oil and mustard oil, with their respective shares of 46%, 16% and 12%. Given the taste preferences and the high price consciousness of the consumers, it is expected that these three oils will continue to account for the bulk of the edible oil consumption in India.

Unfortunately, the increase in the domestic oilseeds production has not been able to keep pace with the increasing demand. In fact, according to figures available, the production of oilseeds grew marginally by close to 2% annually from 2003-04 to 2012-13 as against compounded annual growth rate of 4.6% in demand. Therefore, the gap in demand and supply is being bridged by importing about 9 mmt of edible oil at a cost of about Rs. 65000 crores. The major factors responsible for low and unstable yields are cultivation of most oilseeds crop in rainfed and high risk environments, farmers shifting from higher oil- recovery crops to lower oil recovery crops, and cultivation of other high-priced non-oil commercial crops. Rapeseed-mustard, groundnut

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and sunflower, respectively, have oil recovery ratios of 45%, 40% and 30%, compared to only 11.5 and 17% of cotton seed and soybean. The importance and potential of rapeseed-mustard crop is well known as it is the only crop that can meet the challenge of demand and supply gap of edible oil in India. It is world's third most important source of edible oil after soybean and palm. Each and every part of the plant is of importance in the human livelihood. It is also being utilized for flavouring, medicines and as preservatives, and several value added products since time immemorial. Besides, the several value added products, the question arises whether Brassicas can deliver the Challenge of edible oils need in India?

Historical perspective

Rapeseed-mustard of the genus *Brassica* in the Brassicaceae family play an important role in world agriculture. It is known to be of Mediterranean origin but is also cultivated in Africa and Asia. The crop has enormous diversity and has considerable dietary importance including vegetables, fodder, condiments and edible oil, and is grown in 53 countries of the world. Historically, the Brassicas are one of the oldest and the earliest domesticated crop plants cultivated by man. Citation of this crop in several ancient scriptures and literature suggests that it might have been cultivated as early as 5000 BC. In the Indian sub-continent, the rapeseed-mustard is known to be grown since 3500 BC for oilseed production. The traditionally grown indigenous species are Toria [*Brassica rapa* (L.) var. Toria], Brown Sarson [*B. rapa* (L.) var. Brown Sarson], Yellow Sarson [*B. rapa* (L.) var. Yellow Sarson], Indian mustard (*B. juncea*), black mustard (*B. nigra*) and taramira (*Eruca sativa*/ *vesicaria*), along with non-traditional species including Gobhi Sarson (*B. napus*) and Ethiopian mustard or Karan Rai (*B. carinata*). During *Vedik* period (1500 BC), Indian mustard (*Bhartiya Rai*) was known as "***Rajika***", Yellow Sarson as "***Siddhartha***", and Brown Sarson as "***Sarshap***". The dialect name Sarson appears to be the derivative of the Sanskrit word '*Sarshap*'.

Rapeseed-mustard production scenario

India is the third largest rapeseed-mustard producer in the world, accounting for about 12% of the world's total rapeseed-mustard "seed" and about 8.5% of the world's total rapeseed-mustard "oil". In India, rapeseed–mustard is grown in diverse agro-climatic conditions ranging from north-eastern/north-western hills to down south. The crop is grown sole or in mixed cropping under both rainfed or irrigated conditions. Of the total area and production under the nine oilseeds crops grown in india, rapeseed-mustard accounts for 22.2% of the acreage and 22.6% of the production. The average rapeseed-mustard yield in India is about 1145 kg/ha compared to the combined oilseeds crops average of 1135 kg/ha. In India, although, rapeseed-mustard is cultivated in 13 states, production in Rajasthan, Uttar Pradesh, Haryana and West Bengal, with their respective share of 45, 13, 11 and 8% accounts for 77% of the National total. In the last 15 years, introduction of high-yielding rapeseed-mustard varieties, hybrids, improved production technology, increased area under cultivation; government price support policies and institutional support have revealed positive trends.

Economic importance of rapeseed-mustard and quality edible oil

Revenue generation: Government dependence on revenue from the rapeseed-mustard

On an average, the country produces about 6 mmt of rapeseed-mustard seed annually, and 80% of this is marketed by the small-scale sector in loose form, with only 20% sold by the organized sector. A major portion of seeds enters the regulated *Mandis* (organized markets for selling agricultural products) and is purchased by oilseed crushers for oil extraction and production of oilmeal. Rapeseed-mustard is the largest consumed oil accounting for about 26% of the total edible oil produced domestically. Major consuming states of rapeseed-mustard oil in India are: Gujarat, Maharashtra, Rajasthan and Madhya Pradesh accounting 9%, Delhi, Punjab, J&K, Himachal Pradesh and UP accounting 25% and East West Bengal, Orissa, Bihar, Assam, Chattisgarh, Jharkhand accounting about 30%. The oil content in rapeseed-mustard typically varies between 36 and 45%. Once the oil is extracted, the remaining part of the seed is used to produce rape-

seed-mustard meal, an important source of cattle and poultry feed. Annually, India exports about 7 mmt of seed meals adding about Rs 11000/- crores to the national economy**.** After soybean, rapeseed-mustard meal accounts for about 37.5% of the total seed meal exported from the country. In India, although the personal income derived from agriculture is exempted from income tax, central and state governments generate revenues from oilseed sector by means of several taxes including intra and inter-state sales tax by sellers, about 4 % of value added tax in many states, and 8 % excise duty on branded and packed edible oils by oilseeds crushers; municipalities may also charge *octroi* duties on rapeseed-mustard oil products entering their markets.

Employment generation: Household dependence on revenue from the rapeseed-mustard

Agriculture plays a significant role in the overall socio-economic development of the country. Almost 72 % of the Indian population lives in rural areas, and about 60 % of the country's population depends on agriculture. In rural areas, about 66 % of employed men and 84 % of employed women are engaged in agriculture sector. This high level of dependence suggests that a very significant proportion of the population of the 13 rapeseed mustard growing states are directly or indirectly involved in the production of rapeseed-mustard either as farmers or as labour.

Rapeseed-Mustard oil: One of the healthiest quality cooking oils

Mustard oil contains about 70 % mono-unsaturated fatty acids (MUFA) (42 % is erucic acid, and 12 % oleic acid), 22 % poly-unsaturated fatty acids (PUFA) (10 % omega-3 alpha-linolenic acid and 12 % omega-6 linoleic acid), and 8 % saturated fatty acids (SFAs). Studies have shown that with the low amount of SFAs and high amount of both MUFA and PUFA fatty acids, the rapeseed-mustard oil is considered one of the healthiest edible oils. Compared to other oils mustard oil has several benefits. It has a high content of antioxidants and vitamin E, and because it is cold pressed, has significantly better nutritional value. The presence of alpha-linolenic acid in the mustard oil reduces the adhesion-aggregation tendency of blood platelets which in turn decreases the risk of a heart attack. In fact, the probability of heart disease drops by nearly 70% with the use of mustard oil. Therefore, the future objective in the quality improvement of the cooking oil should be the oil with low saturated fatty acids (d" 6%), high oleic acid (e"60%), moderate linoleic acid (20-25%), low α linolenic acids, and zero trans-fatty acids. However, the oil from double zero genotypes which are free from both erucic acid and glucosinolates is considered best for human health.

Strategic interventions to meet future challenges

Exploitation of genetic- resource potential

The cultivars resistant to biotic (diseases and insect pests) and abiotic (drought, high temperature and salinity) stresses have to be developed by introgression of resistance from wild and related species. Therefore, an extensive wide hybridization programme and use of biotechnological approaches are essential. Work on adaptation breeding, alien introgression and re-synthesis of *Brassica* digenomics for enhancing genetic diversity and breaking of yield barriers must also be initiated.

Hybrid Development

Most successful accomplishments of the present era in the rapeseed-mustard crop improvement programme is the exploitation of heterosis. Since, 2008, five hybrid varieties including NRCHB 506, DMH 1, Coral PAC 432, Coral PAC 437 and 44S01 have been developed and released for cultivation in the mustard growing areas of Rajasthan, Haryana, Punjab and UP. To make the hybrid technology viable, heterosis level has to be enhanced further. For improving oil quality, more efforts are needed in genetic manipulation through the use of biotechnological techniques.

Crop Management Research

For meeting the increased demand of edible oil, future crop production research should focus on sustainable land use, water-saving irrigation, and integrated nutrient management, as well as control of pests, diseases and weeds. Development of new cultivars adapted to multiple abiotic stresses (drought, heat, salinity *etc*.), more resource efficient,

multi-disease resistant and herbicide tolerant etc. are needed. New cropping systems, not only to increase land productivity, but also to maintain their resource base (soil quality, soil health, ecosystem health) and facilitate biodiversity in agricultural landscapes need to be developed. Adoption of conservation agriculture techniques including resource conservation technology, crop diversification, improved disease and pest management, better weather forecasts, effective crop insurance and harnessing the indigenous technical knowledge of farmers would also help greatly for sustainable production of rapeseed-mustard. We are responsible for building up the primary inoculum loads of various pathogens in the soil due to monocropping of Indian mustard. Even after identifying the resistant source for white rust, we are still not able to develop and license a stable white rust resistant high yielding variety. Breeders must jointly make all-out efforts to free the country from white rust by reducing the soil inoculum through cultivation of moderately or highly resistant varieties.

Value-addition in oil and seed meal

The chemical composition of rapeseed-mustard seed offers several possibilities for utilization of this crop for preparation of a number of value added products. Rapeseed-mustard seed contains valuable phytochemicals including tocopherols (vitamin E) and phytosterols. Rapeseed-mustard seed meal contains high-quality protein which can be used as animal feed. Presence of high phenolic compounds in mustard seed meal makes it very effective against yeast and microbes. Nutritional benefits of blending of mustard oil with other edible oils should be explored.

Expansion in rice fallows of eastern India

As rapeseed-mustard group of crops are capable of growing under diverse agro-climatic zones, the 11.65 million hectares of rice-fallow areas of West Bengal, Bihar, Orissa, Jharkhand, Chhattisgarh and NEH states can be harnessed for growing 90-110 days early maturing mustard varieties. Cultivation of rapeseed-mustard crops even in 10% of the rice-fallow areas could very easily increase rapeseed-mustard annual production by at least one million tonne.

Public-Private-Partnership

To meet the growing demand of edible oil production in changing agro-climatic conditions, joint partnership between public and private sector organizations is very essential in both research and extension. The public-private partnership for commercialization of technologies may generate resources for strengthening research in the public-funded organizations.

ICT based technology dissemination

A substantial increase in agricultural yield and output is expected to be realized by implementing, assimilation, and adoption of improved agricultural technology and management practices. Information and communication technology can play a very important role in facilitating rapid, efficient, and cost effective transfer of technology and scientific information to farmers. In rapeseed-mustard, there appears to be a vast exploitable yield reservoir of nearly 25% of the national production which translates into an additional production of 2 mmt of rapeseed-mustard seed. This could be harnessed by the adoption of currently available improved technologies. The present era of ICT plays an important role in educating stakeholders with less dependence on face- to-face communication with the extension workers. Multilingual expert systems for rapeseed-mustard would be very useful and, I believe all would enhance the effective use of ICT in establishing close linkages with the stakeholders. I would like to conclude, by emphasizing that the coordinated efforts of SAUs, ICAR Institutes, State Governments, private agencies and farmers would be able to narrow the gap of edible oil demand and supply in coming years. I am highly confident that the deliberations in this 2nd National Brassica Conference will result in useful recommendations relating to research, development and policy aspects, and will help in developing a roadmap to meet the production requirements of edible oil in the country. I am sure that the rapeseed-mustard group of scientists under National Agricultural Research System (NARS) will definitely meet the aspirations of the Indian farmer. I wish the National Brassica Conference 2014 a great success and once again thanks, the organizers to provide me an opportunity to be with you all and share some of my thoughts on upcoming issues and strategies.