AGRIBLOSSOM
ISSN-2582-8258
A monthly peer reviewed e-magazine for Agriculture & allied Sciences

Sesame (*Sesamum indicum* L.) the emerging oilseed crop: Current status, features, importance and breeding objectives

Tushar Arun Mohanty[1*], Poojashree Mahapatra[2], Digvijay Singh[3] & Nitesh Kushwaha[4]
[1]Department of Plant Breeding and Genetics, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar
[2]Department of Plant Pathology, College of Agriculture, Odisha University of Agriculture & Technology, Bhubaneswar, Odisha
[3]Deptartment of Plant Breeding & Genetics, Bihar Agricultural College, Bihar Agricultural University, Sabour, Bihar
[4]Division of Genetics, ICAR-Indian Agricultural Research Institute, New Delhi
Corresponding author- tushararunmohanty@gmail.com

Introduction

Sesame (*Sesamum indicum* L.) is one of the oldest oilseeds crops widely grown in Africa and Asia for its high-quality nutritional seeds. It is well adapted to harsh environments and constitutes an alternative cash crop for smallholders in developing countries. Sesame is cultivated in diverse agroecological situations. It is called as the "Queen of oil seeds" because of its excellent qualities of the seed, oil and meal. Sesame is highly nutritive (oil 50%, protein 25%) and its oil contains an antioxidant called sesamol which imparts a high degree of resistance against oxidative rancidity. Beside food, sesame has also many potential applications in other areas such as pharmaceutics, industrial and as biofuel. Sesame is used as active ingredients in antiseptics, bactericides, viricides, disinfectants, moth repellants, antitubercular agents and considerable source of Phosphorus, Iron, calcium, tryptophan, methionine, valine, niacin and thiamine. Among the edible oils, sesame oil has the highest antioxidant content and possesses plentiful fatty acids.

Taxonomy and habitat

Sesame also known as Till or Gingelly belongs to genus Sesamum and family Pedaliaceae is an annual shrub with white bell-shaped flowers with a touch of blue, red or yellow with or without branches. There are different colours of sesame like, creamy-white to charcoal-black. This crop is best suited in tropical climates, sandy, well-drained soil with hot climate and moderate rainfall particularly in India, China, South America and Africa. The flowers are purple to whitish, resembling foxglove, followed by

3 cm capsules/ fruits containing numerous seeds. The leaves vary from ovate to lanceolate and are hairy on both sides. The India has been reported to be rich in diversity, particularly in cultivated sesames. In India, besides the cultivated species *Sesamum indicum*, six more wild species have been reported. These include *S. malabaricum*, closest wild relative of cultivated sesame (2n = 26) sharing same chromosome number with the *S. indicum*, an intermediate species complex, *S. mulayanum* (2n = 26), *S. prostratum*, *S. laciniatum* (2n = 32) and the two introduced African species, *S. radiatum* (2n = 64) and *S. alatum* (2n = 26). Two species, *S. Laciniatum* and *S. prostratum*, grow in Africa and India. The observable seed colour shows ranges from black to pure white. Bandila *et al*., accessed the amount of diversity in relation to geographical origins and morphological characteristics of a total of 60 accessions collected from different parts of the India.

Status of sesame production

Sesame is cultivated on 10.56 M ha worldwide. The Asian countries like Myanmar, India and China are the world's largest producers of sesame, followed by Sudan, Tanzania. In 2014, the entire world production was about 5.46 million tons that was grown on 10.56 M ha. The annual area put under it in India is about 2-3million hectares (13.1 % per cent of the world hectare) and the total production is nearly 81 lakh tones. Sesame is grown in just eight Indian states, which are Rajasthan, Madhya Pradesh, Uttar Pradesh Andhra Pradesh, Gujarat, Maharashtra, Tamil Nadu and Orissa.

Nutritional, medicinal and industrial uses of sesame

Sesame seed contains high amounts of (83% - 90%) unsaturated fatty acids, principally linoleic acid (37% - 47%), oleic acid (35% - 43%), palmitic (9% - 11%) and stearic acid (5%-10%) with trace amount of linolenic acid. The high levels of unsaturated (UFA) and polyunsaturated fatty acids (PUFAs) of sesame oil enhance the standard of the oil for human consumption and plays a vital role in preventing heart diseases, atherosclerosis and cancers. Carbohydrates in sesame seed are composed of 3.2% glucose, 2.6% fructose and 0.2% sucrose in conjunction with dietary fibres. Sesame seeds are excellent source minerals like calcium, phosphorous, copper, iron, manganese, magnesium, zinc and vitamin B1. Sesame lignans have antioxidant properties as well as health promoting activities. Sesame seeds contain two unique compounds like sesamolin and sesamin, which increase vitamin E supplies in animals and prevent high blood pressure. Sesame oil contains sesaminol and sesamolinol, that

promotes the integrity of body tissues within the presence of oxidizing compounds. The total phytosterol content in sesame seeds is around 400 mg/100 g, which is higher as compared to English walnuts and Brazil nuts (113 mg/100g and 95 mg/100 g, respectively).

From sesame chlorosesamone has been reported which is a chlorinated red naphthoquinone pigment possessing antifungal activity. There are three anthraquinones, Anthrasesamones A, B and C were isolated from the root of sesame. Sesame can inhibit the growth of malignant melanoma in vitro and also the proliferation of human colon cancer cells. Sesame oil heals and protects areas of mild scrapes, cuts and abrasions. Sesame seed oil was maintaining good cholesterol (high density lipoprotein, HDL) and lower bad cholesterol (low density lipoprotein, LDL). Sesamin binds to and activates a receptor within the body known as Peroxisome Proliferator-Activator Receptor Alpha (PPA Ralpha). Activation of PPA Ralpha will increases gene expression of the fatty acid oxidation enzymes and reduces gene expression of lipogenic enzymes. In other words, sesamin increases the fat burning process and reduces the storage of fat within the body. Sesame seed consumption will increase plasma tocopherol and enhances vitamin E activity, which is reported to prevent cancer and heart diseases.

It was also reported that uses of sesame oil as a therapy for gum disease, treat toothaches, relieve insomnia and also used as an antibacterial mouthwash by Chinese and Indian in the history. Sesamin, one of the major components of lignan of sesame seeds, has received a great deal of interest regarding its potential as a hypocholesterolemic agent. The chemical composition of the white sesame cultivar showed relatively high protein content (25.18%) which is in good agreement with few Indian sesame cultivars (25.4%). The sesame is rich in tryptophan and methionine. Since these amino acids are absent in vegetable protein, sesame meal or flour can be added to recipes to give a better nutritional balance to health food products.

Other application

Sesame oil has been reported as a source for biodiesel and found to give a product with fuel properties extracted chlorosesamone from roots of sesame and found it possess antifungal properties. Sesame flowers have been used to prepare perfumes in Africa. The antioxidant sesamin is used as a synergist for pyrethrum or rotenone insecticides and increases the toxicity of insecticides when sprayed against flies.

Breeding objectives

There are various objectives for sesame breeding.

- High seed yields
- Superior plant architecture (ideotype)
- Indehiscent capsules
- Improved oil quality
- Resistance to diseases and pests

Crop improvement has resulted in rapid replacement of old races, wild and weedy species and cultivars. These materials are excellent source of genes for adoptability and resistance to biotic and abiotic stresses. The genetic resource management includes collections, conservation, evaluation characterization, classification and cataloguing of germplasm. Lack of specific research and understanding of yield-related attributes limited production and extension process of sesame. Yield is an important but complex parameter of crop that is affected by various factors. Development of high-yielding varieties is the ultimate goal of any plant breeder. For efficient crop breeding and improvement, it is of utmost importance to ascertain the contribution of each yield-related trait toward yield, and to select components maximizing yield. Such studies are helpful in determining the model plant type for species. Indeterminate plant growth habit of sesame and seed shattering at maturity resulted in poor adaptation of plant architecture to modern farming techniques (mechanized harvesting). Due to indeterminate sesame growth habit, flowering continues for long time, this heterogeneous capsule maturation causes harvesting problem and yield losses. Development of sesame varieties with improved architecture and determinate habit can assist sesame yield improvement programs. Sesame yield potential is negatively affected by its early senescence and susceptibility to biotic and abiotic stresses. Sesame is susceptible to phyllody disease caused by phytoplasma, resulting stunted plant growth and yield losses. Development of phyllody-resistant varieties is one of the important objectives in sesame breeding program. Sesame wild species possess genes for resistance to biotic and abiotic stresses, which can be introduced into cultivated varieties either through backcrossing or genetic engineering.

Breeding Methods

Plant breeding is a combination of both science and art for effective management of available genetic variability and creation of new ones to attain desired goals. It is the process to identify and select plants possessing desirable traits, and/or to develop an ideal type plant by combining these desired traits into single plant. Breeding methods used for sesame genetic improvement are simple varying from plant selection to hybrid development and molecular breeding. Application of biotechnology and molecular breeding methods can boost the breeding process for development of superior sesame varieties.

Conclusion and future scope

The cultivation apply for sesame crop is simple and applicable for varied ecological conditions starting from tropical to sub-tropical area. There is an incredible application of sesame seed as a multination capsule due to the presence of high oil (83% - 90%) with unsaturated fatty acids as well as proteins, vitamins, minerals and high amount of antioxidant properties. Sesame seed has a potential application as a source nutraceutical for human to prevent malnutrition as well as global food security. Besides, there is also enough scope for development of different value-added sesame products. Various effective strategies should be adapted to produce climate ready planting material to fit the current global environment using modern breeding techniques.

References

Mohanty T.A., Singh U.K., Singh S.K., Kushwaha N. and Singh D. (2020). Study of Genetic Variability, Heritability and Genetic Advance in Sesame (*Sesamum indicum* L.) Genotypes. International Journal of Current Microbiology and Applied Sciences, **9(2):**347-356.

Mohanty T.A., Singh U.K., Singh S.K., Singh D. and Kushwaha N. (2020). Assessment of Genetic Diversity in Sesame (*Sesamum indicum* L.) Based on Agro-Morphological Traits. Current Journal of Applied Science and Technology, **39(25):**101-107.

Pathak K., Rahman S.W., Bhagawali S. and Gogoi B. (2017). Sesame (*Sesamum indicum* L.), an underexploited oil seed crop: Current status, features and importance – A review. Agricultural Reviews. **38(3):**223-227.

Bandila S, Ghanta A, Natarajan S. And Subramaniam S. (2011) Determination of genetic variation in Indian sesame (*Sesamum indicum* L.) genotypes for agro morphological traits. Journal of Research in Agricultural Sciences. **7(2):**88-99