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REVIEW ON THE GENETIC DIVERSITY IN LINSEED (LINUMUSITATISSIMUM L.) IN THE HIGHLANDS OF ETHIOPIA.

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ABSTRACT

Linseed is a multipurpose crop grown for production of stem fiber and seed oil. Linseed Domestication has been inferred genetically from neutral markers and increasingly from specific domestication–associated locus. However, some crops are utilized for multiple purposes that may or may not be reflected in single domestication-associated locus. Due to long-term domestication for fulfillment of these purposes, cultivated flax has diversified into two main types, namely fiber and oil or linseed types, as well as an intermediate type. These types differ considerably in morphology, growth habits and agronomic traits. Fiber-type plants are usually taller and have fewer branches while linseed types are often shorter, have more branches and produce more seeds. The center of origin of flax or Linseed (Linumusitatissimum L.) is uncertain. It is considered that L. bienne as the progenitor of small

seeded flax, originating from Kurdistan and Iran, Flax or Linseed is indigenous to the region expanding from the eastern Mediterranean to India and was presumably first domesticated in the Fertile Crescent. Flax is an annual plant growing 120 cm tall, with slender stems. The leaves are green, 20-40 mm long and 3 mm broad. The flowers are majorly pure pale blue and of various other colors, 15-25 mm diameter, with five petals.

KEYWORDS: Linseed Diversity, origin, Importance, fiber.

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1. INTRODUCTION

Linseed (Linumusitatissimum L.2n =2x= 30) otherwise called as flax, belongs to family Linaceae and order Geranite. It is a resourceful crop, used for fiber as well as oil [1].The Linseed is a conventional oil seed crop has a great economic potential, used in various agro based industries to manufacture paints, varnishes, clothes, patent leathers, printer inks, enamels, stickers, tarpaulins, soaps, linen fabrics, linen threads, canvas bags, quality papers [1].It is one of the widely grown and economically important oil crops for industrial use. The linseed types are grown for extraction of oil from the seeds. The flax types are grown for fiber extraction from the stems. The flax types are relatively taller (80-120 cm) in height with straight culms, less number of secondary branches towards the top of the stem [2].The Ethiopia is considered to be the secondary center of diversity, and now the 5th major producer of linseed in the world after Canada, China, United States and India .Currently, the national productivity of linseed seed is 10 q/ha. The Low productivity of the crop is due to biotic and biotic stress such as; its high sensitivity to fungal diseases, seed bat insect, weed competition and its limited response to inputs [3, 4, and 5]. Linseed requires cool temperatures during its growing period to produce good yields. The mean temperature can range from 10 to 30°C although the crop grows best within 21 and 22°C.

The seed is commonly roasted, ground and mixed with spices and some water to be served along with local breads. It also consumed in soups, soft drinks and with porridges or cooked potatoes [6]. Omega-3 fatty acid makes linseed oil highly sensitive to heat, oxygen and light. Linseed is rich in fat, protein and dietary fiber. Linseed oil has very healthy fatty-acid profile, [7].It is now grown primarily for food and to generate revenue, either in local markets or by export. For food, the seeds are usually roasted, ground, mixed with spices and water, and served with various local breads. It is also consumed in soups, with porridges and cooked potatoes, etc. Limited amounts are also pressed locally for its edible oil, which is often blended with other high quality vegetable oils.

As a result, linseed is currently becoming popular worldwide for its functional food products. Detailed studies were not done to generate adequate information on Ethiopian linseed that is required by the current and future breeding programs. Information on the extent of genetic diversity of Ethiopian linseed landraces and some exotic cultivars based on biochemical characters is meager.

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Flax (Linumusitatissimum L.) is a multipurpose crop grown for production of stem fiber and seed oil [8]. Due to long-term domestication for fulfillment of these purposes, cultivated flax has diversified into two main types, namely fiber and oil or linseed types, as well as an intermediate type [9]. These types differ considerably in morphology, growth habits and agronomic traits. Fiber-type plants are usually taller and have fewer branches while linseed types are often shorter, have more branches and produce more seeds [10]. Linseed is used for food, feed and industrial applications [8]. Flax seeds contain digestible proteins and lignans and their oil is rich in health-beneficial omega-3 fatty acid known as alpha linolenic acid [11]. Flax oil can easily oxidize and harden in contact with the air; hence, it can be used in paints, varnishes, inks, putty, linoleum and other industrial applications [12]. Fiber flax provides fibers for linens, woven or nonwoven textiles, twine and rag-based paper [13]. Both types can serve as feedstock for the production of biomass energy in the bio-fuel industry [14]. Most varieties are either oilseed or fiber types as opposed to dual purpose [13].But the intermediate type opens the door for development of true dual purpose flax [15].Where both stems and seeds have commercial outcomes [16].Flax thrives best in regions with temperate climates under favorable growing conditions, such as moderate warmth, high moisture and well-drained medium heavy soils [17]. Currently, flax is primarily cultivated in western Canada (linseed), the cool-temperate and continental regions of China (fiber and linseed), north-central USA (linseed) and Western Europe fiber [18, 9 and16].

A. Objectives:

- To characterize phenotypic and genetic diversity of Linseed.
- To assess genetic diversity of Linseed.

2. LITERATURE REVIEW

B. 2.1Origin Distribution and Domestication Centre of origin

The center of origin of flax or Linseed (Linumusitatissimum L.) is uncertain. It is considered that L. Bienne as the progenitor of small seeded flax, originating from Kurdistan and Iran, where it is also sometimes considered that L. angustifolium containing high oil content and seed weight, as progenitor, originating from the Mediterranean region and Others suggest that L. Bienne and L. Angustifoliumare the same species, and are widely distributed over Western Europe, the Mediterranean basin, North Africa, the Near East, Iran and Caucasus [19, 20]. Contemporarily, a study with molecular markers advocated that the three species originated

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from one common ancestor, L. angustifoliumbeing most primitive [21]. L. usitatissimum is an annual crop species whereas; the wild forms can also be biennial or perennial. All species are predominantly self-pollinated [20] Cross pollination may occur (Williams, 1988) by artificial means through insects.

C. 2.2 Domestication

Flax or Linseed is indigenous to the large area of land expanding from the eastern Mediterranean to India and was presumably first domesticated in the Fertile Crescent. It is cultivated throughout the world including Canada, India, China, United States, and Ethiopia and all over Europe. Since the domestication of flax, there has been an inclination for growing flax either for its fiber or oil. In the Western region of Eurasia, flax is mostly grown forties fiber, whereas in the Eastern area of Eurasia flax is cultivated for its oil [22].

D. 2.3 Crop Botany

Linseed or Flax cultivars are homogenous, and individual plants are considered homozygous [23]. Flaxis an annual plant growing 120 cm tall, with slender stems. The leaves are green, 20-40 mm long and 3 mamboed. The flowers are majorly pure pale blue and of various other colors, 15-25 mm diameter, with five petals. The fruit is a round, dry capsule 5-9 mm diameter, which may contain up to ten seeds when [24]. It is an herbaceous plant with shallow taproot system that may extend to a depth of 92-122 cm in the coarse textured soil.

E. 2.4 Growth Habit

Flax/Linseed is mainly self-pollinated, but natural crossing is possible through insect. The frequency of cross-pollination seems to be related with varietal differences and environmental factors. In flax, individual flowers open in the first few hours after sunrise on clear, warm days, and the petals usually fall before noon. Most of the commercial varieties have blue petals. Petals may also be white or different shades of purple, blue or pink. The seeds are of various shades of yellow, brown, greenish-yellow, greenish-brown, or nearly black. Seed color of most commercial varieties is light brown. Flax is an excellent companion crop to help establish small-seeded grasses and legumes. Plant characteristics that advocate its use as a companion crop are: (1) limited leaf area and short stature that allow enough light to reach the forage seedlings, (2) early maturity and (3) less extensive root system than many crops which reduces competition for soil moisture. Flax is an annual spring crop with 90 to the 110-day growing

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season. The typical life cycle consists of 45 to 60-dayvegetative period, followed by a 15 to 25-day flowering period, and 30 to 40 day maturation period. Proper harvest time is critical in flax production. Early harvest diminishes yield while late harvest can change the chemical make-up of the oil and thus its quality and value.

F. 2.5 Agronomical Aspects

Fiber flax and linseed perform best in different regions. Fiber flax is mainly grown in climates with a relatively low temperature and high air humidity, which is characteristic for northern temperate regions. The subtropical regions and highlands are ideal locations for linseed cultivation, and, therefore, linseed should be more tolerant to prolonged periods of drought [25]. Although the soil type is not the most important factor in flax cultivation, the sandy clay soils are very suitable for fiber flax cultivation. Flax requires a wide crop rotation of about seven years. Also, the preceding crop is important for growing flax to prevent the occurrence of diseases and lodging.

Flax starts to bloom approximately 11 to 14 weeks after sowing. The flowers are open for only a couple of hours in the morning, after which the petals fall off, and sepals close. 10 to 14 days after flowering the fruit reaches its final size, after which the weight remains stable until it decreases as consequence of the ripening process. At the end of the development the flax plant hardens, turns to yellow (senescence) and loses its leaves. At a certain point, the plants are ready for the retting process, although the seeds might not be fully ripened. The retting process is the most crucial phase of flax cultivation because it determines the yield and quality of the fiber.

G. 2.6 Importance of Linseed

The flax is considered as one of the ancient and most utilitarian crops having separate utility. Cultivar development of flax for consumption is currently focused on augmenting the oil content and nutritional value to meet the requirement of Neutraceutical market supply, as a substitute of fish oil, a rich source of eicosapentaenoicacid (EPA, C20:5) and docosahexaenoic acid (DHA,C22:6). Flaxseed is also rich in soluble and insoluble fibers and lignins, which makes it useful as a dietary supplement. Consumption of flaxseed in daily diet simplifies the risk of cardiovascular diseases such as coronary heart disease and stroke. There is also evidence that flax has anticancer effects in the breast, prostate and colon cancers. Flax fiber is used in the textile industry for making linen cloth and also in paper industry. The

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fibers of flax have great tensile strength, staple length, durability and fineness. They are used in the manufacture of linen cloth and thread, canvas, duck, strong twine, carpets, fish and seine lines, cigarette paper, writing paper and insulating materials. Fibers from the stalks of flax grown for seed are too harsh and brittle for spinning but may be used for other purposes. Some of the benefits of linen are that it is allergy-free, absorbs humidity and allows the skin to breathe, antistatic, antibacterial and low elasticity (fabrics don't deform).Linen can be washed many times without alteration. It can absorb moisture up to 20 times its weight before it feels damp. The residues remaining after the oil extraction from linseed contains about 35-40% protein and 3-4% oil, a rich source of feed to livestock like cattle.

H. 2.7 Genetic Diversity in Flax

The availability and knowledge about the extent of genetic diversity of genetic resource material play a major role in identifying parental lines and developing new varieties with desirable traits. Morphological trait-based diversity assessment has been widely used in crop plants including [26, 27].However the morphological characters are not only sensitive to environmental factors but they also require labor intensive field evaluation over extended periods of time.

3. CONCLUSIONS

The genetic variability Assessment is the first step in any crop improvement programmed. The domestication-associated locus-specific analysis is the complex picture of flax domestication involving multiple paths of domestication, initially for oil. The Diversity analysis is an essential process for precise and accurate identification of the genetic relatedness of the available genetic resources. It is also required for effective choice of parents for next crossing and selection of the progenies. Flax or Linseed (Linumusitatissimum subsp. usitatissimum) is one of the founding crops with diverse importance. Since Linseed, and, in particular, fiber Flax or Linseed, has been such an important cultivated crop, it is of great significance to conserve as widely genetic material of flax as possible for future utilization in breeding. To maintain and exploit these genetic resources efficiently, an understanding of the amount and distribution of genetic variation within and among accessions in a collection is required. Thus, study of the extent and distribution of genetic variation within and among various Linseed germ plasmas are essential for understanding genetic relationships among accessions, and for sampling genetic

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resource for breeding and conservation purposes. Further study research in this area shortly will facilitate germ plasma management and enhance the utilization of germ plasma in designing specific Linseed breeding programmed. Cultivar development of flax for consumption is currently focused on augmenting the oil content and nutritional value to meet the requirement of Neutraceutical market supply, as a substitute of fish oil, a rich source of eicosapentaenoic acid (EPA, C20:5) and docosahexaenoic acid.

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