Chapter I

Introduction
CHAPTER I

INTRODUCTION

Linseed or Flax (Linum usitatissimum L.) belongs to the family Linaceae, is an important oil-cum-fibre crop. It was one among the ‘founder crops’ that initiated agriculture in the old world particularly the Near East (Zohary, 1999). The seed contains 33-47% edible oil while the stem contains 17-37% bast fibre (Muir and Westcott, 2003). Commercially grown cultivars of Linum usitatissimum are grouped into three main types namely, (i) oil type cultivars - also known as linseed or seed flax or crown flax, (ii) fibre type cultivars - also known as flax or fibre flax or long stalked flax and (iii) intermediate type or dual purpose cultivars (Diederichsen and Fu, 2008). However, these forms do not differ botanically hence the terms linseed and flax are often used interchangeably.

Linseed oil, an oldest vegetable oil in the world, is distinctive from other oils as it contains a large amount of (52-63%) α-linolenic acid, a form of omega-3 fatty acids which has desirable cholesterol and health effects (Bronner and Pansu, 1999). However, due to the ω-fatty acid the oil is easily oxidized and becomes rancid with an unpleasant odour within a week, even when kept under cool condition. Linseed oil is generally not recommended for use in cooking (Frankel, 1991) but there is mention on the use of food grade linseed oils in Canada, Japan, USA and European markets as food supplement (Oomah, 2001; Vollmann and Rajcan, 2009). Food-grade oil is extracted in the absence of oxygen (cold-pressed) without adding solvent. Solvent extracted linseed oil is a drying oil i.e. it can polymerize into a solid form. Due to this property, it is used in the manufacture of resin, patent leather, printer ink, enamels, stickers, tarpaulins, soaps, linoleum, as solvent in impregnator, as varnish in wood finishing, as pigment binder in oil paints, as plasticizer and hardener in putty. Flax seed is a good food supplement (Gutte et al., 2015). The seed contains 20 - 25% protein, 42.7% dietary fibre, 24% crude protein and high amount of lignan (Mahan and Stump, 2000; Schmidt et al., 2010). Lignan is a phyto-estrogen. It has antioxidant, anticancer and antiviral properties and reduces cholesterol and heart ailment (George et al., 2007). Flax ranks fourth among the world’s commercial fibre crops (Bolton, 1995). Flax fibre is soft, lustrous, flexible, stronger than cotton fibre but less elastic. The long staple fibres or best grades are used for making linen fabrics whereas the coarser grades or short-fibres, either alone or by blending with cotton and other fibres, are used for the manufacture of canvas, webbing
equipments, twine, rope, insulation materials, fibre reinforced composites, filters, absorbents, pulp and paper (Bledzki and Gassan, 1999; Scheer-Triebel and Leon, 2000; IENICA, 2000).

Linseed is native to the region extending from the Eastern Mediterranean, through Western Asia and the Middle East, to India (Simmonds, 1976). It has been cultivated since antiquity in the Mediterranean Coastal Islands, Asia Minor, Egypt, Algeria, Tunis, Spain, Italy and Greece for fibre and from where the finest linen cloths were spun. It is believed that the oil type cultivars have evolved primarily in South-Eastern Asia, whereas fibre flax developed in the Mediterranean region. Domestication of fibre flax has also occurred in India and China (Radhamani et al., 2006). Linseed can be grown both in tropical and temperate climate, but in the hot and dry regions it is grown primarily for oil purpose whereas in the temperate regions it is more suitable for the extraction of high-grade fibre.

At global level, during 2014, highest linseed cultivated area was reported from Canada (6.21 lakh ha) followed by Kazakhstan (4.46 lakh ha), Russian Federation (4.41 lakh ha), India (3.60 lakh ha) and China (3.10 lakh ha) (FAOSTAT, 2015). The largest production of fibre flax is taking place in China, Russia, Belarus and Ukraine, while oilseed production (for both edible as well as industrial uses) occurs in South Russia, India, Canada, China, USA, Germany, Argentina, UK and Spain.

India is one among the major linseed producing countries in the world. It accounts 12% of world linseed acreage (FAOSTAT, 2014). During 2014-15, the estimated linseed production in India was 1.49 lakh tonnes from 3.23 lakh hectares (DAC, 2016). Madhya Pradesh, Uttar Pradesh, Maharashtra, Chhattisgarh, Bihar, Jharkhand, Rajasthan, Karnataka and West Bengal are the important linseed producing States in India.

Nonetheless, the average productivity of linseed in India is 502 kg/ha, which was not only lower than world average (1,025 kg/ha) but also far below the average yield in Tunisia (2,823 kg/ha), Switzerland (2,631 kg/ha), New Zealand (1,880 kg/ha) and Kyrgyzstan (1,714 kg/ha) (FAOSTAT, 2014). To overcome the problem, it is necessary to evolve high yielding varieties befit to different agro-climatic condition in India.

Improvement in any crop depends on the availability of wide genetic diversity. With regard to linseed, about 48,000 germplasm accessions are being maintained in the national
and international gene banks (Diederichsen, 2007). The National Bureau of Plant Genetic Resources, New Delhi has undertaken several linseed germplasm exploration and collection programmes and assembled a total of 2,365 accessions, of which 2,242 collections were indigenous and 123 were exotic. Another 2,730 linseed accessions are being maintained at the All India Coordinated Research Project on Linseed, Kanpur which includes 2,180 indigenous and 550 exotic accessions (Radhamani et al., 2006).

Divergent selection for fibre flax and linseed flax during the early human dispersion has resulted in a wide range of infra-specific variability in the crop. It is therefore, high time to assess the extent of genetic diversity in the indigenous and exotic linseed germplasm available in India for utilization in the breeding programme. Ayad et al. (1997) emphasized the importance of genetic diversity study in linseed for gaining an understanding on the genetic relationships among accessions, for making core collection and for conservation purposes. Genetic diversity is the pattern of variation, combination of different genes found within the population of a single species. Inclusion of genetically divergent parental lines in the hybridization programme will enable the breeders to combine desirable genes in new recombination or to obtain heterotic crosses.

After reviewing the status of World linseed germplasm collection, Diederichsen (2007) was of opinion that for ensuring long term sustainability in linseed production there is need to collect, conserve the diverse germplasm available across the World. Further, to enhance the overall utility of the linseed germplasm that were stored in the national and international gene banks it is necessary to evaluate or re-evaluate them so as to identify germplasm that exceed the genetic variation found in the recent cultivars for the useful traits. Identification of elite genotype according to the changing need of the consumer/end-user for better oil, fibre and nutritional quality and to overcome the changing biotic and abiotic stresses should be accorded top priority.

Taking into account the importance of linseed crop in India’s economy, the research gaps in the area of germplasm management, the study was contemplated with the following objectives.
• To characterize and evaluate selected indigenous and exotic linseed germplasm available in India for qualitative and quantitative traits.

• To assess the variability and genetic diversity among selected linseed germplasm based on morphological traits.

• To identify potential donors for earliness, seed yield and oil yield in indigenous and exotic linseed germplasm so as to utilize them in linseed improvement programmes.