

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) or bhindi and is also known as lady's finger. Okra is powerhouse of variable nutrients. Fresh edible pods provide human supplementary vitamins such as C, A, B complex, iron, calcium proteins and many others. (Benjawan *et al.* 2007a, b). It is very good source of energy for human diet. It provides 2000 calories while consuming 100g pods. It is not only low in calories but also fat free. Hence, okra is a surprising versatile vegetable. It also holds its high position in the nutritional charts for its fibrous content and other medicinal benefits. The leaves and young fruits of okra are frequently eaten as green vegetable. It is beneficial as anti ulcer, comparable to a standard drug misoprotol with good results. Its alkaline pH could also contribute to its gastro-intestinal ulcers by neutralizing the digestive acids. (Wammanda, 2007). It has been reported that okra has an average nutritive value of 3.21, which is comparatively higher than tomato, eggplant and most of the cucurbits. Okra is multipurpose crop valued for its tender and delicious pods. The dried seeds provide oil, protein, vegetable curd and a coffee additive or substitute. Okra dry seeds are reported to contain 18-20% oil and 20-23% crude protein (Berry *et al.* 1988). Foliage can be used for biomass and the dried stems serve as source of paper pulp or fuel (Martin, 1982). To a limited extent okra is used in canned, dehydrated as frozen forms. In India, okra a major crop cultivated in rainy and summer seasons for its

tender green fruits. This crop is grown in various regions of the country and practically it covers all agroecological zones. (Singh and Bhagchandani, 1967).

Okra is tropical and sub tropical regions of the world. Genus *Abelmoschus* belongs to family Malvaceae and it is generally amphidiploids in nature with $2n=130$. Joshi *et al.*, (1974) reported that there are about 30 species under the genera *Abelmoschus* in the old world and four in the new world. Out of them *Abelmoschus esculentus* is the only known cultivated species. It is native of Ethiopia (Vavilov, 1951). However, Zeven and Zhukovsky (1975) believed it to have originated in Hindustani centre, which is chiefly India. This view is supported by existence of Sanskrit words '*tindisha*' and '*gandamula*' which means okra. Thus, it was inferred that the cultigens might have been originated in Asia or it might originally have been present in Africa and Asia as polyphyletic species (Joshi and Hardas, 1976).

Okra is autogamous and/or often cross pollinated crop. Okra (*Abelmoschus esculentus*) is an erect herbaceous annual having 1 to 2 meter tall. Stem is green or with purple reddish tinge. Leaves are alternate, broadly cordate, palmately 3 to 7 lobed hirsute, serrate. Flowers solitary axillary with about 2 cm long peduncle, epicalyx up to 10, narrow hairy bracteole which fall before the fruit reaches maturity, petals 5, yellow with crimson spot on claw, 5-7 cm long, staminal column united to the base of petals with numerous stamens. Ovary superior, stigma with 5 to 9 deep red lobes, the calyx, corolla

and stamens are fused together at the base and falls as one piece after anthesis. Fruit a capsule, light green pyramidal oblong beaked, longitudinally furrowed 10-30 cm long dehiscent longitudinally when ripe. Seeds are round with green to dark brown colour. The greatest increase in fruit, length and diameter occurs during 6th and 7th days after pollination.

The cultivation of okra extends throughout the tropics and warmer parts of tropical Asia. It is commonly grown in India, Turkey, Iran, West Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, Burma, Japan, Malaysia, Brazil, Ghana, Ethiopia, Cyprus and Southern USA. In India, okra is widely grown in 26 states including union territories. The major area under okra cultivation is West Bengal, Odisha, Gujarat, Andhra Pradesh, Bihar, Jharkhand, Chhattisgarh, Madhya Pradesh, Maharashtra and Haryana. The estimates of area are 534000 hectares and annual production 6361000 Metric tonnes in 2012-2013. However, it was 518000 hectares and 6259000 metric tonnes respectively in 2011-12. (NHB-2011-12, NHB-2012-13 Est.). Andhra Pradesh is the highest producer followed by West Bengal, Bihar and Gujarat. Per capita productivity of Andhra Pradesh (15 tonnes ha⁻¹) is higher than national average (10.5 t/ha.) (NHB 2010). In Maharashtra, the area under okra production is limited due to rainfed farming and lack of wide irrigation facilities. In irrigated areas cash crop like sugar cane, pomogranate, grapes and other valuable vegetables are cultivated on large scale. These crops are providing more benefits to the farmers as compared to okra cultivation. Low

productivity and unstable market rates might be probable reasons for its limited expansion. In India as well as in Maharashtra, okra is mainly grown in rainy and summer season, market rates of tender fruits are cheap in rainy season due to excess production whereas rates are very high during summer season. The most important reason for low productivity is cultivation of open pollinated varieties. Open pollinated varieties are either low yielding or susceptible to biotic and abiotic stress. The farmers are still growing either local varieties or open pollinated varieties.

Germplasm base in cultivated okra is relatively narrow. The countries with the greatest collection are Turkey and India (Sharma, 1993). The narrow genetic base is also one of the hurdles for improvement of this crop. Hybridization is the most successful approach in increasing the productivity in vegetable crops. Selection of genetically superior and suitable genotypes is the most important stage from the standpoint of hybridization of vegetable crops in order to develop new genotypes having desirable characters. One of the main problems of vegetable breeder for developing high yielding varieties through either heterosis breeding or pedigree breeding is to select good parents and crosses. In a systematic breeding program, it is essential to identify superior parents for hybridization and crosses to expand the genetic variability for selection of superior genotypes (Inamullah *et al.*, 2006). The value of any population depends on its potential *per se* and its combining ability in crosses. Selection of parents on the basis of phenotypic performance alone is not a

sound procedure, since phenotypically superior lines may not lead to expected degree of heterosis in F_1 generation or throw superior transgressive segregants in segregating generations. Thus any method which would help in choosing desirable parents for hybridization will be important for the vegetable breeders. Combining ability analysis is important to decide parents, crosses and appropriate breeding procedure to be followed to select heterotic F_1 hybrids or desirable segregants (Salgotra *et al.*, 2009). One of the major problems in okra cultivation in India is lack of locational specific high yielding varieties. In often cross-pollinated crops like okra, improvement in the past was based on selection in locally adapted populations. During recent past, exploitation of hybrid vigour and selection of parents on the basis of combining ability effects have opened a new line of approach in crop improvement. Application of biometric techniques the line x tester analysis has appeared to be the best and vastly useful breeding tool, which gives generalized picture of genetics of the characters under study. Studies on combining ability help to identify the best parents and provide sufficient genetic information on the inheritance of a character.

In Indian scenario, okra is cultivated more or less all regions of country and covers practically all agroecological zones. There are various genotypes of okra having varying yield potential, adaptability to different climatic conditions and response to disease, insects and pests. The performance of genotypes keeps changing in varying environmental conditions. The genotypic

and environmental interactions are usually present under all conditions in purelines, hybrids, synthetics or any other material used for breeding, which complicate the breeding work and forbid the progress of the crop improvement programmes (Eberhart and Russell, 1966). Thus, it is incumbent to study the performance of a crop over several or a wide range of environments. Such genotypes will be very useful for utilizing their potential for the development of stable and high yielding varieties and hybrids.

In present situation the area under hybrid vegetable is steadily increasing. More than 100 hybrid varieties are under cultivation in different vegetables. Hybrid varieties of okra are gaining popularity because of their resistance to biotic and abiotic stresses and response to input conditions (Sharma *et al.*, 2006). Therefore, in present investigation, attempts were made to understand heterosis, combining ability and mode of gene action. In okra, there are very few references were available on Genotype x Environment interaction (GEI) or stability. In present context, stability analysis was carried on five seasons (three kharif and two summer season) to identify stable parents and cross combinations.