REVIEW
OF
LITERATURE
2. REVIEW OF LITERATURE

The importance of genetic divergence in any breeding programme is very well known. Variation may arise either due to environment or genotypes or both. The magnitude of genetic variability present in the crop species is of utmost importance as it provides the basis for effective selection.

The literature pertaining to divergence studies in basil has been reviewed under the following heads:

2.1 Variability, heritability and genetic advance
2.2 Correlation and path coefficient
2.3 Genetic divergence

2.1 VARIABILITY, HERITABILITY AND GENETIC ADVANCE

The divergence is the major component for crop improvement programme. Whereas heritability is an important selection parameter, which helps in identifying the genetic behaviour of genotype. Verma et al. (1989) observed variation for different morphological traits in different species of Ocimum. Leaf and inflorescence/stem ratio varied from 1.0-5.5 in O. sanctum and 1.0-3.3 in O. citriadorum (EC 110586) and essential oil content varied between 0.16% in O. basilicum (EC 112807) and 0.43% in O. basilicum Indian basil. The height total essential oil yield (280.4 t/ha) was obtained from Indian basil followed by French-basil Bangalore selection (229.4 t/ha).

The aromatic plants viz., lemon grass (Cymbopogon flexuosus), plamarosa (Cymbopogon martini) and bhuthulasi (O. basilicum) and the
medicinal plant Kalmegh (Andragraphis paniculata), senna (Cassia angustifolia) and aswagandha (Withania somnifera) were studied for their adaptability and economic viability on the rainfed. Alfisols of Prakasam district of Andhra Pradesh for three years during 1998 to 2001. Based on the productivity and economics of cultivation, lemon grass, plamarosa among aromatic crops and aswagandha and senna among medicinal crops could be included as viable crop alternatives in the tobacco based cropping system of the Prakasam district of Andhra Pradesh.

Tayal and Dutt (1938) obtained oil by steam distillation of the whole plant (from North India) gave a pale yellow oil in 0.7% yield with an intense and characteristic odour of lemon and an appreciable note of lavender, another species of oil (from South India) had a mild comphoraceous odour. The characteristics of oil obtained from different localities in India. The oil content citral (up to 60%) along with linalool, geraniol and citronellol and their esters, citronella methylheptenone and methylecinnamate, small amounts of eugenol, acetic acid and citronelic acid are present.

Pushpangadon et al. (1982) genetic upgrading of Ocimum viride wild for improving, thymol and total oil yield. In proceeding of National seminar on medicinal and aromatic plants and divided the genus into basilicum and sanctum groups on the basis of study on morphology, cytogenetics, breeding behaviour, chemical and distributional characteristics, but in view of the limited number of species studied the scope remained quite narrow.

Bonnardecoux (1992) extracted essential oils by steam distillation from whole plant or from flowers only. Essential oil yield were higher from plants harvested when they were 3-11 cm. in length.
Putievsky (1993) observed variation in seed yield per plant production from green and dried plants. Lee et al. (1994) reported higher essential oil content of leaves and greater total oil content per plant. Thoppil and Jose (1994) observed variation in the quantity and quality of the essential oils in the four botanical varieties of *Ocimum basilicum* Randhawa and Gill (1995) observed highest yield of essential oil at 100% flowering and found that essential oil content increased with plant development. Szabo et al. (1996) investigated the morphological and chemolaxonomic variability of 13 basil (*O. basilicum*) genotypes. They also studied plant height, secondary branches, leaf: stem: flower ratio and essential oil contents in different plant organs.

Seed dormancy studies in some *Ocimum* species and its control through chemical treatment was done by Gupta (1996).

Gupta (1996) reported high degree of variation in *Ocimum* species for herbage and oil yield composition depending upon the ontogenetically stage of the plant at the time of harvest, using various chemotypes of *Ocimum basilicum* var. *glabratum*, *Ocimum basilicum* var. *minima*, *Ocimum americanum*, *Ocimum sanctum*, *Ocimum viride*, *Ocimum kilimandscharicum* and *ocimum gratissimum*, the effect of growth stage on oil yield, herbage yield and oil composition was examined over three consecutive seasons. It was found that although the herbage yield for all *Ocimum* species/varieties (chemotypes) around the initiation of seed formation (180 days after planting), the maximum oil yield for only *Ocimum basilicum* var. *purpureascens*, *Ocimum viride* for only *Ocimum sanctum*. For the other species/varieties (chemotypes) examined, the maximum oil yield was found to be the 50% seed set stage (210 days) or between the 50% seed set stage and the full seed maturation.
stage (210-240 days). For *Ocimum basilicum* var. *glabratum* (camphor type), *Ocimum basilicum* var. *purpureascense* (methyl cinnamate -type), *Ocimum gratissimum* (eugenol-type), *Ocimum viride* (thymol-type) and *Ocimum sanctum* (eugenol-type), the major component reached its maximum around 180 days after planting. For *Ocimum canum* (linalool-type) the linalool content did not change throughout its complete life cycle. The maximum content of the major constituent of all over *Ocimum* species (chemotypes) except *Ocimum* varied (thymol-type) occurred at the 50% seed set stage (210 days). Finally for *Ocimum viride* (thymol-chemotype) the phenophase for maximum content of the major constituent was between 180-240 days.

Supat (1996) grown sweet basil in December, January and February. Planting dates had an effect on plant width, height, number of primary branches, days to flowering seed yield and seed quality. The widest bush, early flowering and maximum number of primary branches, highest seed yield and seed germination were obtained from plant grown in November-December. The best season for showing in the plain of India is October-November and in the hills March-April.

Lachowicz et al. (1997) observed differences in morphological features, growing characteristics and yields of essential oil productive per-unit area of land. He observed that anise basil was most production in terms of plant biomass, while cinnamon basil produced the most essential oil.

Verma et al. (1998) observed high range of variation in eight genotypes belonging to seven *Ocimum* species (99.2 to 415.1 q/ha) and oil yield (43 to 160.4 l/ha) in three cuts taken during the year. Highest herb and oil yield was recorded from *O. basilicum* (French basil), followed by *O. citriodorum* (EC
yielding 394.2 q/ha herb and 157.8 l/ha oil. The oil content on fresh weight basis varied from 0.21 to 0.51 percent. It was highest for *O. canum*, followed *O. carinorum* (0.48%) and *O. basilicum* Indian basil (0.46%). High heritability (broad sense) and high genetic grain for oil yield, fresh herb yield and oil content in that order indicates great possibility of further improvement for these characters through appropriate plant breeding methods.

Putievsky et al. (1999) observed intermediate variation in morphology. The essential oil composition of the F₁ and F₂ plants were not always consistent with those observed in the parent plants. Karlovic et al. (2001) observed great variability of morphological characters among the basil genotypes. They recorded considerable variation for all agronomic traits except plant height and number of branches per plant. Dry leaf weight per plant varied from 6.56 g (*O. basilicum* cv. *Dark Opal* from Slovakia) to 17.86 g (*O. basilicum* var. *Difforne* from Germany).

Vieira et al. (2001) studied morphological, chemical and genetic differences of 12 tree basil (*O. gratissimum*) genotypes to determine whether volatile oils and flavonoid can be used as taxonomic markers and to examine the relationship between random amplified polymorphic DNA and these chemical markers cluster analysis showed that there were three groups genetically distinct and highly correlated to volatile oil constituents.

Ahmad and Khaliq (2002) collected seeds of four genotypes from different localities of district Poonch were sown in pots and transplanted to the field. They found large diversity among genotypes for leaf area, number of racemes per plants, number of flowers per raceme, plant height, 1000-seed weight and days to seed maturity.
Singh et al. (2002) analyzed variations for morphology, phenology and essential oil composition in genotypes of sweet basil (O. basilicum L.) an important medicinal and aromatic crop. Significant variations were observed for morphological and essential oil traits. Tesi and Lenzi (2002) described the behavior of some dwarf genotypes of basil. They also studies plant growth and seed production of basil genotypes. The dwarf genotypes showed a large decrease in the length of spike and seed production.

Panwar (2007) found high heritability for seed yield per plant, leaf stem ratio, 1000-seed weight and plant height. However, high genetic advance was observed for fresh herbage yield per plant, seed yield per plant, plant height and dry herbage yield per plant.

2.2 CORRELATION AND PATH COEFFICIENT

Sheen et al. (1991) obtained oils from various parts (leaf, flower, stems, whole plant and leaf flower) of Ocimum basilicum, which were categorized into five groups by preference ranking test of their aromas. High statistical correlations were found among the volatile components of the oil, duration, sensory evaluation.

Sharma (2005) found positive and significant correlation of seed yield per plant with days to flower initiation, days to seed maturity, plant height, primary branches per plant, lamina length, spikes per plant, spike length, 1000-seed weight and essential oil content both at phenotypic level. Lamina width showed positive correlation with seed yield per plant at phenotypic level, while, it was found to be negatively correlated at genotypic level. The positive and significant correlation between plant height and spike length, lamina length and lamina width, lamina length and 1000-seed weight, spike length
and number of flower whorls per spike and 1000-seed weight and seed yield per plant were recorded. He observed the genotypic correlation coefficients were in general, higher in magnitude than the phenotypic correlation coefficient. He analyzed the path coefficient analysis and found the 1000-seed weight had the largest positive direct effect on seed yield per plant followed by spike length, lamina length, spikes per plant, primary branches per plant, days to flower initiation, plant height and days to seed maturity at phenotypic level, while, days to flower initiation had highest positive direct effect on seed yield per plant followed by plant height, lamina width and essential oil content at genotypic level. The largest negative direct effect was observed for number of flower whorls per spike at phenotypic level but the highest negative direct effect on seed yield per plant was observed for spike length at genotypic level.

Panwar (2007) observed that fresh herbage yield per plant had high positive correlation with lamina length, dry herbage yield per plant, seed yield per plant and essential oil yield per plant at genotypic level.

Panwar (2007) found that fresh herbage yield per plant had highly significant positive correlation with dry herbage yield per plant however positive and significant correlation with lamina length, seed yield per plant and essential oil yield per plant were also observed.

Panwar (2007) obtained that fresh herbage yield per plant had the highest direct positive effect on essential oil yield per plant followed by number of flower whorls per spike, plant height, dry herbage yield per plant, number of spikes per plant, 1000-seed weight, days to seed maturity, seed yield per plant and lamina width. The maximum direct negative effect was
observed essential oil content followed by spike length, lamina length, days to flower initiation, number of primary branches per plant and leaf stem ration.

2.3 GENETIC DIVERGENCE

Mahalanobis (1936) developed method for quantifying the genetic divergence between the diverse populations. Ahmad et al. (2002) observed large diversity for leaf area number of racemes/plant, number of flowers/raceme, plant height, 1000-seed weight and days to maturity among different genotypes of Ocimum.

Mahalanobis et al. (1949) reported that for distinguishing racial types, an anthropologist had used a single character or sometimes a binary or tertiary combination of characters. They found more flexible method where the compounding coefficients are chosen in such a way that the new set of varieties can be arranged in decreasing order of capacity for discrimination. These were called canonical variety. The manner in which these compound coefficients are chosen is that they have special reference to the group under consideration. The use of canonical variety facilities, the study of group consultation also serves as special as a pictorial representation of configuration of various groups.

Rao (1952) analyzed the data of genetic divergence using Töcher's Methods and grouped the genotypes into different clusters. Hammer et al. (1996) evaluated 182 Ocimum genotypes for growth characteristics and yield components and observed wide range of differences within the different species and races.

Karlovic et al. (2001) observed great divergence of morphological characters among the basil accessions. They recorded considerable variation
for all agronomic traits except plant height and number of branches per plant, dry leaf weight per plant varied from 6.56 gm. (*O. basilicum* cv. Dark Opal from Slovakia) to 17.86 gm (*O. basilicum* var. Difforme from Germany).