INTRODUCTION
CHAPTER-1

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In a country like India, having predominantly vegetarian population, food legumes, commonly known as pulses, are major source of dietary protein. Pulses contain around 20 to 30% protein which is 2 to 2.5 times higher than that of cereals. Besides, their nutritional value, pulses also provide nutritious green fodder and feed for livestock. During past four decades, the area (22-24 million hectares), total production (10-13 million tonnes) and productivity (475-544 kg/ha) of Pulses have virtually remained stagnant, even though a modest increase in overall production has been witnessed in the last few years in India. Due to stagnation in the pulses production on one hand and ever increasing population on the other, the availability of pulses has also declined sharply from 64 g/capita/day during 1940-56 to less than 40 g/capita/day during 1987-88 (Paroda, 1990). This is much below the minimum per capita per day requirement of 80 g and optimum per capita per day requirement of 105 g, recommended by World Health Organisation (W. H. O.) .

The above facts vividly demonstrate the seriousness of the situation and call for an urgent need for increasing the production of pulses in the country.

One of the most important pulse crops of Asia, is Mungbean (*Vigna radiata* (L.) Wilczek), also known as greengram, which is rich in protein that is digestable and produces low flatulence. Mungbean has established itself as a highly valuable short duration
## TABLE 1.1

**Nutritional Composition of Greengram grain**

(Rathore 2000)

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Content</th>
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</thead>
<tbody>
<tr>
<td>Total carbohydrates (%)</td>
<td>62.6</td>
</tr>
<tr>
<td>Crude protein (%)</td>
<td>23.86</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>1.15</td>
</tr>
<tr>
<td>Crude fibre (%)</td>
<td>5.27</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>3.32</td>
</tr>
<tr>
<td>Lysine (mg/g)</td>
<td>436</td>
</tr>
<tr>
<td>Methionine (mg/g)</td>
<td>75</td>
</tr>
<tr>
<td>Cystine (mg/g)</td>
<td>55</td>
</tr>
<tr>
<td>Food energy (calories)</td>
<td>347</td>
</tr>
<tr>
<td>Digestibility (%)</td>
<td>79</td>
</tr>
<tr>
<td>Biological coefficient (%)</td>
<td>72</td>
</tr>
</tbody>
</table>
grain legume crop with wide adaptability, low input requirements. It and the ability to improve the soil by fixing atmospheric nitrogen is well-suited to a large number of cropping systems. Mungbean is highly nutritive (Table 1.1) and it constitutes an important source of protein in the cereal based diets of many people in India, and other Asian countries, like Pakistan, Thailand, Indonesia, the Philippines and China. The relative importance of mungbean in total pulse production in South and South-east Asia has greatly increased during the past 20 years (Singh, 1988).

The Global mungbean growing area has been doubled in the last twenty-five years with an annual increase rate of 2.5% (Kim, 1996). Its popularity among the farmers has grown due to its tremendous potential in alleviating the hunger and supplementing farmers' income along with improving the soil fertility. The demand for mungbean may significantly exceed the supply in the next two decades (Babu and Hallan, 1988; Jansen, 1992). Mungbean is an important source of foreign exchange for a number of Asian countries including Thailand, China and Indonesia which export the produce to other countries; India and Taiwan being the main customers.

The average productivity between different mungbean growing countries varies from 200 kg/ha to about 800 kg/ha. In India, productivity has increased reasonably during past two decades reaching around 300 kg/ha (in states like Karnataka and Madhya Pradesh) to around 600 kg/ha (in states like Punjab, Maharashtra and Gujarat). Some twenty years back the national average of
productivity was less than 200 kg/ha due to cultivation of totally indeterminate and late maturing varieties, like B-1, Kopergaon and jawahar-45, however, with the development of semideterminate and early maturing varieties like PS-16, Pusa-105, ML-267, Pant and PDM selections, the average productivity of 482 kg/ha has been attained currently which is much below the higher productivity level of around 800 kg/ha of other countries like Thailand, Taiwan and the Philippines etc. In Uttar Pradesh, Mungbean cultivation in 1998-99, was under 110.03 thousand hectares of land with a production of 47.2 thousand tonnes and productivity of 428.00 kg/ha (Anonymous, 1999). Although, a marked increase in area and productivity has been obtained at the state as well as country level in past two decades, it is still very far from being satisfactory as compared to the productivity level of 800 kg/ha of some other countries. The main reason for low productivity is the lack of high yielding and disease resistant mungbean varieties adapted to different seasons, cropping systems and agronomic conditions. Thus, there is an urgent need of developing high yielding and disease resistant varieties of mungbean so that this crop can fulfil its potential in combating the malnutrition prevalent in primarily vegetarian population of our country.

The available germplasm serves as most valuable natural reservoir in providing donor parents for incorporating and/or improving the characters by genetic restructuring of plants for developing high yielding crop varieties (Hawkes, 1981). Therefore, collection, conservation and evaluation of germplasm is essential for
present as well as future crop improvement programmes (Vavilov, 1951; Harlan, 1956). The proper evaluation of germplasm is essential for understanding its potential value as a breeding material (Ritcher, 1983). Although, India is one of the important centres of diversity for mungbean so far very little systematic germplasm collection, conservation and evaluation work has been accomplished. Moreover, the germplasm resources cannot be utilized properly unless their potential is ascertained under the local conditions or environment for which the breeding programme is aimed.

The genetic improvement in any crop depends upon the available genetic variability and its judicious exploitation through efficient breeding methods. The evaluation of available genetic variability for quantitative characters and disease resistance plays a vital role in deciding the effective selection criteria for genetic amelioration in self-fertilized species like mungbean. Since selection acts on available genetic variability to evolve superior genotypes, the nature and amount of genetic variability available in the germplasm indicates the scope of improvement in the characters through selection. However, the efficiency of selection in improving the characters by exploiting the genetic variability depends largely upon the extent of transmissibility of the characters in question. The genotypic, phenotypic and environmental coefficients of variation are helpful in exposing the nature of variability in the populations whereas, the estimate of heritability provide the index of transmissibility of characters. The parameter genetic advance unfurls
more clear picture about the overall efficiency of selection by taking into account the scope and effectiveness of selection for improving a character conditioned by its genetic variability and transmissibility. Thus, estimates of direct selection parameters like coefficients of variation, heritability and genetic advance are useful in formulating a suitable selection strategy for high yield in mungbean. Although, some literature in respect of genetic variability and direct selection parameters is available in mungbean, most of these studies are based on the limited samples of material (Sawarkar, 1978; Natarajan et al., 1988; Malik and Singh, 1991; Pundir et al., 1992; Byregowda et al., 1997).

Selection for yield per se, may not be effective, since, yield is a complex character which happens to be an end product of multiplicative interactions among various yield components (Grafius, 1959). Therefore, for attaining higher yield levels in crops such as mungbean, the breeder is required to simplify this complex situation by handling of yield components; Therefore, identification of important yield components and information about the nature and magnitude of their direct and indirect contributions towards the manifestation of grain yield is very essential for devising successful crop breeding strategy. The correlation and path-coefficient analysis provide information about the relative importance of various yield components in the expression of yield and thus, help in formulation of appropriate selection strategy. The results of earlier workers pertaining to correlation and path-coefficient studies in mungbean have
been found to be non-consistent and varied with the materials and environments used (Chyau et al., 1979; Choudhary, 1985; Nafade, 1988; Satyan et al., 1989; Pundir et al., 1992; Naidu et al., 1994; Kumar et al., 1995; Sarma and Talukdar, 1996).

The selection of suitable diverse parents for hybridization is an important step for any crop improvement programme for getting desired recombinants in the segregating generations (Moll et al., 1962). The multivariate analysis based on Mahalanobis D² has been widely used as successful method of genetic divergence analysis for discriminating the breeding materials on the basis of genetic diversity in several crop plants (Mehndiratta and Singh, 1971). The D² analysis classifies the genotypes into homogeneous groups/clusters with little within cluster diversity while, diversity between two clusters is usually high. Thus, representative genotypes from diverse clusters can be earmarked for utilization in hybridization programme depending upon breeding objective. The literature in respect of genetic divergence studies in mungbean is meagre (Gupta and Singh, 1970; Natarajan et al., 1988; Naidu and Satyanarayana, 1991; Sarma and Talukdar, 1991; Mishra et al., 1995 and Sharma et al., 1996).

There are numerous high yielding pureline varieties in various mungbean crop but, in general, they lack greater resiliences to fluctuating in environmental conditions. It is, thus, important to develop varieties with consistently good performance across wide spectrum of environments. As the stability in performance of any population is governed by polygenes for yield and its stability and

The results of earlier studies regarding germplasm evaluation, genetic variability, direct selection parameters, correlation, path analysis, genetic divergence and stability analysis are relevant only for the materials and environments involved in the particular study and cannot be generalized. Therefore, studies on the above aspects on the available germplasm under the environment, where it is to be exploited, are essential for successful utilization of germplasm resources for the development of superior varieties. In view of the foregoing facts, the present investigation was undertaken with the following objectives:

Objectives:
1. To evaluate germplasm for important characters in selection to their suitability to different environments.
2. To assess the extent of variability, heritability, and genetic advance for various characters.
3. To estimate the correlation coefficients among different characters.
4. To study the direct and indirect effects of yield components on
seed yield by path coefficient analysis.

5. To examine the genetic divergence existing in the germplasm collections.

6. To understand the role of genotype x environmental interactions in expression of various characters and stability of genotypes.