INTRODUCTION

I N T R O D U C T I O N

India possesses very large livestock population of about 416 million heads (Anonymous, 1987), yet production of milk and other livestock products in our country are lowest. Milk availability in India is just 110 grams per person per day whereas, world average is 303 grams per day and the recommendation by Indian Council of Medical Research is about 201 grams per day (Singh and Moor, 1982). Milk yield per milch animal in India is 685 Kg per year, one of the lowest in the world, whereas, it is as high as 8125 Kg per animal per year in Israel (Anonymous, 1985). Kay (1946) reported that, essential and fundamental obstacle is the shortage of concentrated protein food being particularly severe. Milk yields are absurdly low when compared with the proved potentialities of many Indian breeds as milking animals.The main reason for the poor performance of our animals is shortage of quality fodder rather than low genetic potential.

Most of the work on livestock improvement in India has been directed towards breeding and health; while the vital aspect of quality feeding, without which neither of these can be fully effective has been neglected. If, a proper standard of nutrition for human beings is to be maintained, then, live stock must be fed with quality fodder in the green or conserved state along with concentrates and other feeds to supplement the grazing. It becomes quite necessary to go in

for the cultivation of fodder crop to supplement and reduce the pressure on natural grazing and to replace as far as possible the low quality straw which presently form the bulk material for animal feeding. In India the most of the fodder for animals consist of the straw of rice or wheat. These dry fodder's nutritive ratio is over 1:40 (protein : total digestible nutrient) and therefore, obviously unsuitable for animals. The nutritive ratio of ration must not be wider than 1:10 and for the higher the yield of milk narrower should be this ratio. Grasses such as Sudan grass, Guinea grass, elephant grass and the spear grasses have nutritive ratio in the range of 1:12 to 1:10. These grasses are, therefore, responding good sources of nutrients for milch animals. But the fodder of outstanding value are the leguminous crops. Example berseem, lucerne fodder have nutritive ratio of 1:4 to 1:6 and ideal for the milk production provided due regard is given to the protein/carbohydrate ratio (Russel, 1937 and Wright, 1937).

Grazing and quality fodder resources contribute to the better feeding of livestock and so to better human nutrition. In Karnataka, Karnataka Dairy Development Corporation has introduced and yet to introduce many forage legumes to meet the forage demand of dairy industry. The main and immediate dairy problem of peasant is that of providing

sufficient feeding stuffs containing enough protein even for his very small stock of milk producing animals.

A thriving dairy industry in India would demand cultivation of fodder crops more particularly legumes in arable rotations and mixed farming systems to improve the fertility and reduce the erodibility of soil, to provide adequate and balanced amount of protein and carbohydrate to the livestock for more milk for better nutrition to a primarily for vegetarian people and cultivation of better drought tolerant plant.

Legumes belongs to the family Fabaceae is the third largest family of flowering plants comprising about 650 genera and 18,000 species. The legume species are found in tropics, sub-tropics, temparate, arid zone, highlands, savanna and low lands, there are even a few aquatic legumes. In India the family Fabaceae is well represented by about 1,100 species belonging to more than 100 genera. Legumes encompass vines, shrubs, and even as forest trees. Most of the world's exquisite flowering plants are legumes.

The legumes are rich in high quality protein, which is one of the essential food constitutes not only for human consumption but also for domestic animals. Legumes are also high in calcium and a good source of vitamins, especially A and D. These qualities make legumes one of the best food

for man and almost indispensable for efficient, economical livestock feeding. The protein content of legume directly related to their high nitrogen content and in this respect they differ markedly from the grasses or other non- legumes.

Cultivation of large varieties of legumes since, ancient times, improvement in the fertility of soil from growth of legume crops was known to Indians, since, 370 B.C. (Theophrastus, 370-285 BC). Legumes play a very important role in the nitrogen economy of soil as they are endowed with unique capacity for fixing atmospheric nitrogen in association with root nodule bacteria. Leguminous crops can add upto 500 Kg of nitrogen to the soil/hector/year (NAS, 1975). Symbiotic nitrogen fixation by legumes going to remain an important feature of agriculture despite the increased use of fertilizer nitrogen. With the introduction of high yielding varieties of crops the need for keeping the cost of agricultural production low is keenly felt. One such input that accounts for major cost of production is fertilizer nitrogen. It is possible through mixed cultivation of legumes with other crops will reduce the cost of crop production.To improve the productive capacity of soil, several system of agriculture have developed. In each of these systems legumes usually play a pivot role. Because of their multiple advantages, legumes are exploited as green manure, forage plant, to protect the soil erosion, to assist in maintaining

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soil fertility and in improvement of soil texture has led plantation agriculture to introduce a system of planting a fast growing perennial legume cover crops between the rows of the main plantation crops. Such cover crops have been introduced to young plantation of rubber, oilpalm, coconut and sisal.

Legumes have gained great popularity and economic importance wherever they are grown, 1) because of their higher nitrogen content and feeding value, 2) because of their large quantity of readily decomposible organic matter, 3) because of their versatility in fitting, into special farm practices, especially soil improvement 4) because of the most of the world's exquisite flowering plants, and, 5) many of the legumes plants are having medicinal properties and industrial applications, etc.

Exploration of forage crops with varieties of characters like higher productivity and quality is one of among the many ways of increasing the total fodder production. Forage *Clitoria ternatea* one such crop for tropical region which has not been exploited fully.

The *C. ternatea* L. commonly known as butterfly pea, or a mussel shell climber or kordofan pea, originated within tropical Asia and is widely distributed in the New and Old world including Australia (Whyte *et al.*, 1953). In India, it

is distributed all over the country. It is a pretty ever green and perennial climber with attractive blue or white flowers available throughout the year, has an ornamental value also. Therefore, it is cultivated in many gardens for flowers (Burns, 1918),and he has quoted varieties with many variations in colour shades of flowers such as deep indigo blue, blue, white and blue with double flower. In India particularly Karnataka state, varieties with blue, white flower are common, whereas, double white and blue flowers are confined to western ghats.

C.ternatea is one of the leguminous forage plants, which is fairly drought resistant and widely accepted as pasture, cover crop and as a green manure throughout the world (Carrol, 1934; Whyte, 1957). It is successful fodder plant for grazing alone or in association with other perennial grasses and is also salinity tolerant. It was found well adopted for heavily cracking soil as well as fertile soil in North Australia and North West Queens land, coastal grass lands of Ghana (Hassel, 1945; Jones *et al.*, 1970; Katiyar *et al.*, 1970; Garza *et al.*, 1972; Crowder, 1974; Menendez and Machado, 1976; Keoghan, 1979; Anonymous, 1980-82; Wagner, 1981; Osman and Diek, 1982; Adjel and Fiana, 1985 and Hall, 1985)

C. ternatea proved to be suitable for improving grass lands (Chakravarty, 1970) and also suitable as fodder plant in both irrigated and rainfed condition in Tamilnadu (Anonymos, 1964). Matos *et al.* (1977) obtained highest yield of fresh fodder in *C.ternatea* in irrigated and non-irrigated condition. It was found to be resistant to trampling, recovered well after grazing (Garza *et al.*, 1972).

C.ternatea was found to be an active fixer of nitrogen and dry matter yield was high and consistant over years than those from cowpea, soyabean and groundnut (Musa and Burham, 1974).

C.ternatea is also predominantly an important medicinal plant. It's roots extracts are used in cooling, cathortic, diuretic, antiheminthic and also in ascities, headache, fevers, elephantiasis, leucoderma as well as in enlargements of abdominal vicera and as a remedy for eye diseases like ulcers of cornea (Watt, 1889; Dymock *et al.*, 1890-93; Agharkar, 1953).

In Indonesia, an infusion of roots of white flowered variety is considered as blood purifying and juice of leaves and flowers are used to wash eyes in a slight form of conjunctivitis. The crushed leaves of blue variety act as maturation in boils and abscesses when applied externally (Van Steenis Kruseman, 1953).

In India, the plant is known from ancient times (in Sanskrit text on medicine such as Shaligram nighantuh, Dhanvantri nighantuh, its various uses are explained). It is believed that white flowered variety of *C.ternatea* most effective on burning sensations, snake bites, and in diseases caused by Graphapida, whereas, blue flowered variety cures dysentry,insanity, intoxication, cough and dermatosis. It is one of the plant used under trade name "Shankapushapee" a widely reputed ayurvedic brain tonic (Aiyer and Kolammal, 1964).

In Maharashtra, particularly in kokan region, root juice is used to remove phlegm in chronic bronchitis. Its root pulp is used in asthama, as an emetic and also in rheumatism. Seeds contain a fixed oil tannic acid and a better acid resin and is utilised as purgative, aperient, diuretic, cathertic and antihelminthic. Infusion of leaves is used for eruptions (Watt, 1889; Dymock *et al.*, 1890-93; Kirtikar and Basu, 1918; Agharkar, 1953 and Nadkarni and Nadkarni, 1976).

Natives of Sri Lanka consume green tender pods as vegetables (Allen and Allen 1981). The blue corollas yield blue dye which is used for colouring boiled rice (rice cake) in Amboyana (Rumphius, 1786; Burkill, 1935). The anthocyanin pigment in this dye may have wider application in food

technology due to its natural origin, stability and nontoxicity (Lowry and Chew, 1974). In Malaysia, the dye is used for dying mats. It is also used as a litmus indicator of acidity and alkylinity. (Allen and Allen, 1981).

C.ternatea is found to be easily palatable for the livestock and it has been proved to be good quality ration for sheep (Garcia, 1968; Katiyar *et al.*, 1970 and Hall, 1985). It is universally accepted as a cover crop and utilized as forage and green manure in many countries, though in India it is more or less a neglected species. Only in the konkan region, the species is grown on bunds or hedges and is consumed by cattle as a forage.

Relatively very little work has been done on this species. Some evalutionary attempts have been reported by the Indian Grassland and Fodder Research Institute, Jhansi and the Central Arid zone Research Institute Jodhpur. These institutes have proved that this plant as promising one as it remains green almost all the year round and can withstand cutting and grazing to some extent (Chakravarthy, 1970; Anonymous, 1974).This species is reported to yield maximum quality forage in October (Rai and Kanodia, 1980). This plant is found to be quite palatable to animals particularly sheeps in both green and dry state (Katiyar *et al.*, 1970).

Chemical constituents of *C.ternatea* has been studied by Kulkarni *et al.* (1988), and have reported, the alcoholic extraction of *C.ternatea* in 230 and 460 mg/kg,ip, doses producted increased sedation, diminished alterness, inhibited conditioned avoidance response and hypothermia equivalent to chlorpromazine 10mg/kg,ip,in rats and mice. Analgesic and local anaesthetic properties were also, observed to moderate extent. Analysis of protein and fatty acid contents of *C.ternatea* has also been studied by Joshi *et al.*, (1981) and trypsin inhibitor by Macedo and Jose (1992). Autopolyploidy in *C.ternatea* have been studied by Srivastava and Raina (1982). Karyotypic analysis of *C.ternatea* of different varieties have been worked out by Mathew and Ninan (1989) and detailed cytological studies were made in *C.ternatea* var blue flower plants treated with variable concentrations of ethyl methane sulfonate and maleic hydrazide (Patil and Bhat, 1992). Information on inheritance and linkage relationships in *C.ternatea* is extremely meagre, are mostly restricted to the petal colur and flower form only (Rant, 1922) later, Sen and Krishnan (1961 b) studied the genetic basis of flower colour and flower form in *C.ternatea*. Pollen fertility and inheritance of flower colour in *C.ternatea* has been reported by Saroja, 1961 and Chow, (1978) respectively.

Despite its multiple uses not much importance is given for its genetic improvement and also lack of sufficient

genetic variability for economically important characters is one of the reason attributed for failure in improvement of legumes in general. Being predominantly self fertilized, inherent variability in this legume is much confined. Creating variability through hybridization and intermating is a laborious exercise. In this regard techniques of mutation breeding have greater role in generating variability. Mutation breeding has been used in recent years as a valuable supplement to other methods of plant breeding in generating variablity and development of crop plants of a new architecture, superior biochemical constitution. Induced mutations have decided advantage of their own and can be employed in the improvement of crops. The utility of this method is evident from the fact that in several crops induced mutants have been directly released as new varieties. So far, about 1019 experimentally produced mutants have been developed and officially released as approved varieties in the world including 160 in India (FAO/IAA, 1991). More than 280 of them belong to the asexually propagated species have been found useful in agriculture and horticulture (Broertzes and Herton, 1978). In crops, particularly in cereals, about 101 varieties developed through mutagenes have been officially released (Gottschalk and wolf, 1983). However, only 24 variety have been released in legumes. This shows that

legumes have received less attention even in mutational studies.

In past, mutation breeding was emphasised for induction, identification and use of macromutations. Yield and related characters are controlled by polygenetic system. Brock (1965, 1970) reported that these characters can be altered positively or negatively by mutations. The importance of polygenic mutations in alternations of economically important characters is duly understood and recognized during the last 3 decades. Among the different quantitative characters leaves, flower, protein content are of prime importance. The concept and importance of mutations have been discussed in detail by Gaul and Co-workers (Gaul, 1965, 1966; Gaul *et al.*, 1969 etc.).

Therefore, an attempt has been made to generate variability through induced mutation in this legume *C.ternatea* by employing chemical mutagens.

The compact, highly branched erect and variegated nature of the foliages desirable in order to improve its horticulture value as well as high growth, high branching pattern, shrubby nature are desirable for grazing animals while crops are in standing and improved protein enhance their forage value. Several growth modifier as well as mutagens are known to induce said characters in plants.

The present study has been designed to know the effect of EMS and MH in M_1,M_2 and M_3. generations, with following objectives:

1. To know the response of material to the mutagens in M_1 generation.
2. To estimate the induced frequency of chromosomal aberrations with EMS and MH treated populations of *C. ternatea*.
3. To find out the frequency and spectrum of chlorophyll and viable mutations in M_2 and M_3 generations and to isolate desirable viable mutants of practical utility.
4. To make a comparison of mutagenic ability of growth retardant MH with a potent mutagen EMS in *C.ternatea*.
5. To study, the effect of chemical mutagen in increasing variability for desirable characters.
6. To assess the mutation frequency for quantitative charac ters in M_2 and M_3 generations.
7. To enhance the horticultural and forage value of *C.ternatea* by induced mutation.