CHAPTER I

GENERAL INTRODUCTION

United Nations Educational Scientific and Cultural Organisation (UNESCO) declared the potato as the food of the future during the “International year 2008” and stated the increasing value of the potato as the 3rd most important world food crop (Gottschalk, 2011). World potato production has increased over the past decade at an annual average rate of 4.5 per cent. Mainly in the developing countries like China and India, the demand and consumption for potato production is growing as an alternative commodity to the traditional food crops such as cereals (rice and maize) (Wang and Zhang, 2004).

The expansion of potato cultivation in the Indo-Genetic plains has been among the most remarkable developments in the evolution of the crop Worldwide during the last half century (Bardhan, et al., 1999). From a meagre 1.285 million tonnes (t) and 205,000 hectares (ha) in 1949 (Srivatsava, 1980), potato production in India now has passed 34 million t (Anon.2011a) with projections forecasting 50 million t by 2020 (Anon., 1997). As output continued to expand in recent decades, India has raced up the charts to become the World’s second largest potato producing country (Scott and Suarez, 2011).

The potato belongs to the family Solanaceae and genus Solanum. Within the genus Solanum, over two thousand species have been described. This genus is sub divided into several sub sections, of which the subsection potato contains all tuber-bearing species. The subsection potato is further divided into series, one of which, Tuberosa, contains about 54 species, both wild and cultivated. One of the theses species is S tuberosum, which is further divided into two sub species; tuberosum and andigena. The subspecies tuberosum is widely used as cultivated crop plant. The sub species andigena is also cultivated, but its cultivation is restricted to Central and South America. The centre of origin and diversity for wild tuber-bearing potato (subsection potato) lies in Latin America. For the series Tuberosa (to which S tuberosum belongs) and most other series within the subsection potato, there are two centres of diversity; one is a long stretching Andean area in Venezuela, Columbia, Ecuador, Peru, Bolivia and Argentina. The other is Central Mexico. The early potatoes introduced in Spain and other part of Europe belongs to S tubersoum ssp andigena. This introduction was adapted to European long day conditions through selection. The present day cultivated tetraploid S tuberosum ssp tuberosum is considered to be the selections from this
introduction. It has been now shown that such a transition from *andigena* to *tuberosum* can take place in a fairly short period of approximately 10 years of selection. This new type of potato spread from Europe to all over the world as a cultivated crop (Khurana, *et al*., 2003).

Potato productivity was 6.44 t/ha in the year 1949-50 that increased to 21.25 t/ha in the year 2010-11 (Anon, 2012) largely due to technological interventions made by the Indian council of Agricultural Research. Though, productivity of India is better than other top producers like China, Russian countries. Physiologically potato is capable of producing 120 t/ha. Therefore, we have to exploit the potential of this wonderful crop to the maximum extent through our varietal development programme. Productivity in major potato producing states of India is already more than 20 t/ha and many of the progressing farmers are harvesting 35-40 t/ha. One of the reasons of getting poor productivity by subsistence farmers is the non use of improved hybrids and non adoption of modern agro-techniques.

Potato is grown in India in almost all the states and under very diverse conditions. Plateau regions of south-eastern, Central and peninsular India, constitutes about 8 per cent area where potatoes are grown as rainfed *kharif* crop during rainy season (July to October) or as irrigated *rabi* crop during winter (October to March).

Potato cultivation in Karnataka occupies an area of about 0.083000 million ha with a total production of 0.470000 million tonnes (Anon.2011). Potato is grown in four out of ten agro climatic zones of Karnataka viz., Southern Transitional (Hassan and Chikmagalur), Hilly Zone (Chikmagalur), Northern Transitional Zone (Belgaum and Dharwad) and Eastern Dry Zone (Kolar, Chikkballapur and Bangalore Rural). Among the seven districts, Hassan district alone contributes more than 71 per cent of area and potato production in Karnataka. Despite, the cultivation of potato in larger extent of area, the productivity in Hassan region is only 5.87 t/ha where the updated national productivity is 18.81 t/ha. Though CPRI, Shimla has developed and released 49 hybrids, till today the Kufri Jyoti is being used by farmers as commercial hybrid in the region. (Basavaraj *et al*., 2009). The low productivity in the region found to be due to many important reasons, among them; are 1. Non-availability of suitable high yielding different maturing group cultivars for the zone/area, 2. Variation of the environment in the area, 3. Improper adoption of management practices and 4. Pests and diseases.

To improve crop production within a specific agro ecological Zone, it is necessary to evaluate the genotypes/hybrids for early bulking, ability to tuberise under higher
temperatures, resistance to bacterial wilt and mites as well as potato tuber moth etc (Pandey and Sarkar, 2005). Hassan region of Karnataka is also facing low productivity even though it has got potentiality for good potato production as demonstrated by some progressive farmers by producing 25-30 t/ha. Hence, it is essential to evaluate different genotypes/hybrids for heat tolerance, early maturity, medium maturity and for processing hybrids for suitability to this region.

Since 1970, majority of the farmers have ignored the supplementation of organics (FYM/leaf mould/vermi compost etc.,) in addition to mineral fertilizers in cultivation of different crops. Resulted in poor soil fertility status, poor resistance of the crops to pests and diseases, low yield and finally ended with low benefit cost ratio due high cost of inputs. To cope with the situation, most efficient hybrids which have high yielding capacity along with characters viz., heat tolerance, short duration, medium duration, processing hybrids and field tolerance to major pests and disease are required. To realise higher income from potato cultivation, adoption of integrated approach with the appropriate quantity of organics, use of suitable hybrids which adjusted to different cropping systems/early planting/medium late planting/processing etc, use of bio fertilizers, foliar application of organics etc. may be helpful to counter the problem of low productivity.

Phosphorous is one of the major nutrients, second only to nitrogen in requirement for plants. A greater part of soil phosphorus, approximately 95-99% is present in the form of insoluble phosphates and cannot be utilized by the plants (Vassileva et al., 2001). To increase the availability of phosphorous for plants, large amounts of fertilizer are being applied to soil. But a large proportion of applied fertilizers of phosphorus quickly transformed to the insoluble form (Omar, 1998). Therefore, very little percentage of the applied phosphorus is available to plants, making continuous application necessary (Abd Alla, 1994). This over fertilization often leads to an imbalance of nutrients in the soil and is one of the major environmental concerns. There has been a continuous search for viable alternatives in the chemical phosphatic fertilizers. However, phosphorus deficiencies are wide spread in soil throughout the world and phosphorus fertilizers represent major cost for agricultural production.

Microbial community influences soil fertility through soil process viz., decomposition, mineralization and storage and release of nutrients. Microorganisms enhance the P availability to plants by mineralizing organic P in soil and by solubilising precipitated
phosphates (Chen, et al., 2006; Kang et al., 2002; Pradhan and Sukla, 2005). The bacteria in the presence of labile carbon serve as sink for P by rapidly immobilizing it even low P soils (Bun and Mann et al., 2004). Among the soil bacterial communities ectorrhizospheric strains from Pseudomonas and Bacilli and endo symbiotic rhizobia have been described as effective phosphate solubilizers (Igual et al., 2001). Bacillus magaterium, B circulans, B subtilis, B polymyxa, B circalmous, Pseudomonas striata and Enterobacter could be referred as the most important strains (Subbarao, 1988; Kucey et al., 1989). Strains from bacteria genera, Pseudomonas, Bacillus, Rhizobium and Enterobacter along with Pencillium and Aspergillus fungi are the most powerful Phosphate solubilizers (White law, 2000).

Soil P precipitated as orthophosphate and absorbed by Fe and Al oxides is likely become bio available by bacteria through their organic acid production and acid phosphate secretion. Although high buffering capacity of soil reduces the effectiveness of PSB in releasing P from bound phosphates; however, enhancing microbial activity through P solubilising inoculants may contribute considerably in plant P uptake. Phosphorous solubilising bacteria’s mainly Bacillus, Pseudomonas and Enterobacter are very effective for increasing the plant available P in soil as well as the growth and yield of crops. So, exploitation of PSB through bio fertilization has enormous potential for making use of ever increasing fixed P in the soil and natural reserves of phosphate rocks (Subbarao, 1988). Similar to other crops in potato phosphorous is also most important limiting nutrient which grown under long day and rain fed conditions and has special significance in acidic soils of North West Himalayas where P fixation is a problem. Studies conducted in high hills of Shimla have shown that potato responds well to P application (Grewal and Sud, 1990). Higher requirement of phosphorous fertilizers and enormous rise of the cost of the fertilizers necessitates the judicious use of phosphorous fertilizers in the crop cultivation. Numerous soil micro flora were reported to solubilise insoluble phosphorous complexes into solution and make it possible for its use by the plants (Tripura et al., 2005). Several groups of fungi and bacteria, popularly called phosphate solubilising micro-organisms (PSM’s) assist the plants in mobilization of insoluble forms of phosphate; PSMs improve the solubilisation of fixed soil phosphate, resulting in higher crop yields and therefore are used as bio fertilizers. A significant increase in the phosphate uptake in the potato tubers was observed when Pseudomonas striata, Aspergillus awamori and Bacillus polymyxa were used either alone or in combination (Gaur and Ostwal, 1972). Local / native Phosphate Solubilising Bacteria’s
found to be appropriate to use, made available bound form of phosphorous and reduce the cost towards phosphatic fertilizers.

The microbial inoculation with PSB may also augment the efficiency of applied super phosphates by reducing phosphate fixation by soil fractions. The seed inoculation of Streptomycin resistant mutant of *P striata* (M-20) and *P striata* (27) improve the nodulation, the available P2O5 content of the alluvial soil, root and shoot bio mass, straw and grain yield and phosphorus and nitrogen. (Gaind and Gair.1991.)

Nitrogen fixation in legumes, crop quality and resistance to plant diseases are the attributes associated with phosphorous nutrition. These are strong evidences that soil bacteria are capable of transforming soil phosphorous to the forms available to the plant. Microbial biomass assimilates soluble P and prevents it from adsorption or fixation (Khan and Joergesen, 2009)

Liquid seaweed fertilizer had influence on growth parameters such as plant height, fresh weight, dry weight of plant and fruits, fruit yield, length and breadth of fruits and number of fruits in okra (Zodope, *et al.*, 2008). Blunden *et al.*, (1996) reported that the seaweed extract applied as foliar spray enhanced chlorophyll level in plants also reported high Mg and Fe content in *Sargassum*, this might have influenced the synthesis of chlorophyll. The same trend was observed in the *H. musciformis* with NPK application in black gram (Tamilselvan and Kannan, 1994) *Vigna catajung* and *Dolichos biflorus* (Anantharaj and Venkatesalu, 2001, 2002). The seaweed extract prepared from *Sargassum wightii* was found to be promising in possessing fertilizer activity. Hence, this simple practice of application of eco friendly seaweed liquid fertilizers to vegetables is recommended to the farmers for attaining better growth and yield over chemical fertilizers.

The plants treated with higher seaweed dosage up to 2g plus chemical fertilizers, carbohydrate and protein contents of marigold seed were increased. The brown seaweed *Sargassum wightii* contained higher amount of cytokinins (192 µg/l) than the auxin (90µg/l). Analysis of SLF (Seaweed Liquid Formulation) among the macronutrient revealed that potassium was maximum followed by magnesium, calcium, nitrogen and phosphorous. Among the micro nutrients, chlorine content was maximum followed by Iron and ferrous.
Biologically active compounds, which are present in plants, act as elicitors to induce resistance in host plants resulting in reduction of fungal disease development (Vidhya Sekaran, 1992). The role of defense related enzymes in the induction of resistance against plant pathogen have been reported by several workers (Castillo et al., 1992; Shivakumar, et al., 2003). Use of PHYTON-T with mancozeb was found effective in increasing the plant growth, yield and the late blight disease reduction in potato (Raghavendra et al., 2008).

The studies were undertaken to evaluate some of the recently developed/released potato hybrids for their suitability for cultivation in Hassan region and also to evaluate the influence of a few organic supplements on the growth and yield of most popular variety Kufri Jyoti with the following objectives:

1. To establish the correlation among various morphological and tuber attributes and path analysis for yield characters
2. To screen genotypes/hybrids for their storage behaviour and processing characters
3. To evaluate the genotypes/hybrids for the incidence of major diseases and pests
4. To evaluate the efficacy of genotypes/hybrids for their suitability to Southern Transitional Zone of Karnataka