CHAPTER I

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is one of the ancient and very important commercial crops of global perspective and has retained its unique name and fame as “King of fibres” and “White gold” because of its higher economic value among cultivable crops for quite a longer period. It has a significant role in Indian agriculture in terms of industrial development, employment generation and national economy. It plays a key role in socio-economic and political affairs of the world. It provides employment to 70 million people and contributes nearly 75 per cent of total raw material to the textile industry in India (Kairon *et al.*, 2004).

Cotton is grown in 80 countries and 123 countries are involved in the cotton related activities. Among 123 countries, 38 countries are the major producers and also the consuming countries, while, 30 countries are major raw cotton exporters and 25 countries exclusively import cotton (AICCIP, 2016). The global cotton production is 96.5 million bales. India ranks first in the world in cotton production with 26.4 million bales followed by China, United States of America, Pakistan etc. India is the second largest consumer and exporter representing 5.3 and 5.8 million bales, respectively in 2015-16. Tamil Nadu requires 100 lakh bales per annum, but production is only 5 lakh bales. Hence, it is essential to produce more cotton to meet its demand (USDA, 2016).

Though India is the largest producer, second largest exporter and consumer of cotton, the demand for cotton is expected to remain robust in India. In future there is a need to improve the productivity to meet this increasing demand. Indian cotton production is mired by low productivity driven by rainfed cultivation, small farm size, increasing pest and disease, inadequate inputs, lack of awareness about modern cultivation practices among Indian farmers, lack of irrigation facilities, lack of proper timing of field operations and too much dependence on labour to cultivate cotton (Majumdar, 2012). Cotton cultural operations need a paradigm shift towards mechanized farm operations from ploughing and seeding to all intercultural operations.
Cotton is a labour intensive crop. On an average, a total of about 100-110 man-days are required for one hectare cultivation to include all operations such as sowing, weeding and harvesting. Generally cotton sown manually, consumes more seed rate and labour cost. The labour requirement for sowing cotton is higher (15%), which is next to harvesting operation (44%). Thus, it results in higher cost of production. Further, the lack of agricultural labour lead to increase in production cost, therefore mechanization represents an important factor to reduce the costs and increase the productivity (Hobbs, 2003). The proportion of human labour cost to total cost of cotton is the highest in the cultivation of cotton crop over the years. It ranged between 25 and 50 per cent in various states. The human labour use increased positively from 96 man-day/ha in the pre - Bt cotton period (1996-2001) to 104 man day/ha in the post - Bt cotton period (2002-2008) mostly for the harvesting activities on account of higher yield. It was observed that, the average daily wages of agricultural labourers has increased by more than 80 per cent from the pre - Bt cotton to the post - Bt cotton period, for all kinds of farm operations. The percentage increase in female labour wages was around 10 times more than their male counterparts. It was seen that at the All India level labour wages were the highest for post harvesting operations followed by picking of kapas (Haque et al., 2015). So, there is need for machine sowing to avoid the labour dependence (Vaiyapuri, 2004). Sowing cotton with inclined plate planter saves 46.2 and 97.1 per cent in labour cost and time (Chandel et al., 2010).

Weeding is another important labourious practice; one third of the cost of cultivation is spent on weeding alone when carried out with the manual labour. The arduous operation of weeding is usually performed manually with the use of traditional hand tools in upright bending posture, inducing back pain for majority of labourers. Hand weeding requires more labour, consumes more time leading to higher cost of weeding. An estimate of 400-600 man-hr/ha (Tajuddin, 1996) is the normal man-hour requirement of hand weeding which amounts to ₹ 2200/ha, which also depends upon weed infestation level and labours are not easily available in peak seasons. Traditional methods are costly and time consuming. On the other hand, bullock drawn implements have certain draw backs like low field capacity, high maintenance cost, limitations of adverse weather conditions etc. and are therefore not affordable to the
farmers. The power weeder was found useful for weeding in between standing rows of cash crops of cotton. The weeder could cover an area of one hectare in a day of 8 hr. The cost of weeding by this machine comes to only onethird of the weeding cost by manual labourers (Tajuddin, 2006).

Drip irrigation and fertigation in cotton helps the farmers to reduce the cost of cultivation especially in labour intensive operations like weeding, irrigation etc., and it reduces cost of irrigation by 50 per cent. In addition to labour saving following automation, greater efficiency is achieved through other cultural operations like thinning, spraying, weeding and harvesting of row crops etc., while the crop is still irrigated. Moreover, labour and operational costs can be reduced by the simultaneous application of water, fertilizer, herbicide, insecticide, or other additives through the drip system (Narayananamoorthy, 2008).

Amongst all operations, cotton picking is the most difficult, tiresome and tedious job. The average labour requirement in conventional practice of hand picking of cotton in India was reported to be about 517 man-hr/ha (Prasad et al., 2004). It is not only a tedious job but also ten times costlier than irrigation and twice more costlier than the weeding operation (Prasad and Majumdar, 1999). In recent years labour shortages during peak periods of cotton production, have been quite frequent and widespread.

Hence, it is necessary that development/identification of a mechanical picker suitable for Indian conditions. Mechanical pickers will be useful in minimizing drudgery involved in hand picking as well as enhancing production of cleaner grade of seed cotton. The mechanical cotton picking system will also be helpful in achieving timeliness of operation for the next crop. With recent developments in technology, battery powered portable handheld cotton picking machines are also available, which the farmers can use with ease. On an average, the machine can harvest 20 Kg of seed cotton per one hour and 150-180 Kg for six hours, while manually the maximum harvest per day would be 10 Kg to 15 Kg only (Selvaraju, 2016).

Within this context, a better understanding of the Indian cotton sector and the impact of mechanization on cotton cultivation need to be assessed. Labour cost in India is rapidly increasing and therefore mechanization in cotton cultivation will play a key role
in keeping the cost under control. The possibilities of mechanical picking need to be assessed. Cotton being an indeterminate plant, it is difficult to have single harvest. But research recent results suggest that high density planting is a way to harvest seed cotton mechanically. However, to bring high density planting coupled with mechanization requires manipulation of crop geometry especially by providing closer spacing to ensure one time harvest and the yield reduction may be compensated by increasing the plant population by way of high density planting system (Singh et al., 2016).

The manipulation of row spacing, plant density and the spatial arrangements of cotton plants, for obtaining higher yield have been attempted by agronomists for several decades in many countries. The most commonly tested plant densities range from 5 to 15 plants/m² (Kerby et al., 1990) resulting in a population of 50000 to 150000 plants/ha. The concept on high density cotton planting, more popularly called Ultra Narrow Row (UNR) cotton was initiated by Briggs et al. (1967). The obvious advantage of this system is earliness (Rossi et al., 2004). The UNR cotton plants produce less number of bolls/plant than conventional cotton but retain a higher percentage of the total number of good opened bolls per unit area in the first sympodial position and a lower percentage in the second position (Vories and Glover, 2006). The other advantages include better light interception, efficient leaf area development and early canopy closure which will shade out the weeds and reduce their competitiveness (Wright et al., 2011). The early maturity in soils that do not support excessive vegetative growth (Jost and Cothren, 2001) can make this system ideal for shallow to medium soils under rainfed condition, where conventional late maturity hybrids experience terminal drought.

Therefore, the high density planting system (HDPS) is now being conceived as an alternate production system having a potential for improving the productivity and profitability, increasing input use efficiency, reducing input costs and minimizing the risks associated with the current cotton production system in India. It facilitates the mechanical picking by ensuring the synchronized maturity.
Hence, in order to reduce the cost of cotton cultivation, the present study was carried out with the following objectives.

1. To determine the effect of crop geometries on growth, yield and quality of cotton
2. To study the influence of mechanized cultivation on growth, yield and quality of cotton
3. To evaluate suitable crop geometries to suit farm mechanization
4. To work out the economics and energy of cotton under mechanized and conventional cultivation with varying crop geometry.