I INTRODUCTION

Cotton is a natural fibre produced by four different species of *Gossypium*. Approximately 95% of the cotton is produced by the *G. hirsutum* L. species; therefore, this review will concentrate primarily on that species, with a few exceptions. Cotton is used every day in the form of clothing made from cotton fibre and products made from cotton-seed oil. Cotton is the most widely produced natural fibre in the world, but there is increasing competition from man-made fibres. Cotton seed is a by-product of the more valuable cotton fibre and is a valued raw material for food oils for human consumption and high protein feed for livestock.

Cotton is a perennial shrub with an indeterminate growth habit and although it grows naturally to 3.5 m in the tropics, it is grown commercially as an annual crop. Wild ancestors of cotton are found in arid regions, often with high daytime temperatures and cool nights, and are naturally adapted to surviving long periods of hot dry weather. Modern cultivars have inherited these attributes, making the cotton crop well adapted to the intermittent water supply that occurs with rainfed (dryland) and irrigated production (Hearn, 1980). Compared with other field crops, however, its growth and development are complex consequences of the indeterminate habit. Vegetative and reproductive growth occurs simultaneously, sometimes making interpretation of the crop's response to climate and management difficult.

Worldwide, cotton is already broadly adapted to growing in temperate, subtropical and tropical environments, but growth may be challenged by future climate change. Production may be directly affected by changes in crop photosynthesis and water use due to rising [CO_2] and changes in regional temperature patterns (Reddy *et al.*, 2000; Oosterhuis, 2013). Indirect effects of climate change will likely result from a range of government regulations aimed at climate change mitigation. These impacts will also occur in light of other pressures that will be placed on cotton production systems, such as reductions in land and water availability, rising costs of production and a decline in trade as a result of competition from other commodities and man-made fibre.

To meet these challenges and opportunities, sustainable cotton production will need to adopt practices, in combination, that will: (i) increase and/or maintain high yield and fibre quality; (ii) improve a range of production efficiencies (water, nutrition and energy); (iii) seek to improve returns for lint and seed; and/or (iv) consider other cropping options as alternatives. Crop management and plant breeding options include: (i) high yielding/high quality stress-tolerant cultivars; (ii) optimizing water; (iii) manipulating crop growth and maturity; (iv) varying planting time; (v) optimizing soil and health for crop nutrition; and (vi) maintaining diligent monitoring practices for weeds, pests and diseases to enable responsive management.

The essence of this review is to:

1. Summarize the impacts and challenges that climate change will have on cotton production in different regions across the world.
2. Compile and summarize climate change impacts on cotton growth and production.
3. Document research and management practices that may help with adaptation relevant to modern cotton farming systems.
4. Outline research approaches to address climate change.

II CLIMATE CHANGE IMPACTS ON MAJOR COTTON PRODUCTION REGIONS

While there is growing confidence in global scale observations and predictions of climate change, it is still difficult to determine precisely how spatial variation of climate change will translate into impacts at regional scales especially in production agriculture. Nonetheless, there are some general principles about the variability of climate change between locations, and current climate models provide some indication of locations where impacts are likely to be most severe.

There have been substantial increases in atmospheric CO_2 concentration ([CO_2]) since the beginning of the industrial age. The natural atmospheric [CO_2] during the past 800,000 years ranged between 170 and 300 μmol mol^{-1} (CSIRO, Bureau of Meteorology, 2012). Atmospheric [CO_2] has increased in the past 200 years from a pre-industrial concentration of about 280 μmol mol^{-1} to almost 400 μmol mol^{-1} in 2014 (IPCC, 2013; Tans and Keeling, 2015), with projections for further increases in the future. The rate at which atmospheric [CO_2] is rising is also increasing: global atmospheric [CO_2] increased from 2009 to 2011 at a rate of 2 μmol mol^{-1} year^{-1} (CSIRO, Bureau of Meteorology, 2012).

It is projected that atmospheric [CO_2] will be around 450 μmol mol^{-1} for the period centred on 2030. There is little difference in projected atmospheric [CO_2] in the near future (i.e. 2030) among