Sustainability assessment of cotton based intercropping systems for productivity and profitability using different quantitative indices under semi-arid vertisols

G. RAVIDRA CHARY\textsuperscript{1}, CH. SRINIVASARAO\textsuperscript{2}, G.R. MARUTHI SANKAR\textsuperscript{3}, P.G. PATEL\textsuperscript{4}, R. N. SINGH\textsuperscript{5}, M. MGANVIR\textsuperscript{6}, M.B. NAGDEVE\textsuperscript{7}, V.D. MOHOD\textsuperscript{8}, RAJBIR SINGH\textsuperscript{9}, N. RANI\textsuperscript{10} AND SIDHARAM\textsuperscript{11}

All India Coordinated Research Project for Dryland Agriculture, Central Research Institute for Dryland Agriculture, PO Saidabad, Hyderabad, Telangana 500 009

Received : June 2014; Revised accepted : November 2014

ABSTRACT

Field experiments were conducted to evaluate cotton (\textit{Gossypium} spp.)-based intercropping systems with greengram (\textit{Vigna radiata} (L.) Wilezek), blackgram (\textit{Vigna mungo} (L.) Hepper), pigeonpea (\textit{Cajanus cajan} (L.) Millsp.) maize (\textit{Zea mays} L.) and soybean (\textit{Glycine max} (L.) Merril.) as intercrops in semi-arid (moist) Vertisols at Khedbrahma (Gujarat) and soybean and pigeonpea as intercrops in semi-arid (moist) Vertisols at Akola during rainy seasons of 2008–09, 2009–10 and 2010–11. The intercropping systems were evaluated for superiority based on cotton equivalent yield (CEY), rainwater use efficiency (RWUE), monetary returns, sustainability yield index (SYI) and three competition indices, viz. land equivalent ratio (LER), relative crowding coefficient (RCC) and competition ratio (CR). At Khedbrahma, cotton + blackgram (1:1) was found to be an efficient system with significantly higher mean CEY (983 kg/ha), net returns (₹18,893/ha), benefit: cost ratio (2.68), RWUE (2.23 kg/ha-mm), higher SYI (70.4) and LER (1.44) and lower total CR (2.17). At Akola, cotton + soybean (1:1) was found to be efficient with significantly higher mean CEY (1,609 kg/ha) besides higher net returns (₹35,177/ha), benefit: cost ratio (2.94), RWUE (3.68 kg/ha-mm), higher SYI (34.1) and LER (1.31) and lower total CR (2.19). Further, the multi-tier system of cotton + soybean + pigeonpea + soybean (3:2:2:2) was the second best with higher productivity, benefit: cost ratio and RWUE. Cotton + blackgram (1:1) at Khedbrahma and cotton + soybean (1:1) at Akola were identified as efficient intercropping systems and could be adopted under similar agro-ecological settings in the respective domains.

Key words: Competition indices, Cotton-based intercropping systems, Rainwater use efficiency, Sustainability Yield Index, Semi-arid Vertisols

In rainfed agriculture, the production risks are high due to weather aberrations i.e. delayed onset of monsoon, early, midseason and terminal droughts during various phenological stages of the crops. Therefore, the dry spells occurring at various phenological stages of the crop would reduce the yield by about 25 to 50% under different soil and agro climatic conditions. Though, mixed/intercropping is an old and widespread practice to minimize the production risks in rainfed agriculture, the changing cropping patterns, cultivars and management practices necessitates to evaluate the performance of existing intercropping systems or to identify new intercropping systems. In the long duration cotton crop, mixed/intercropping is practiced under rainfed condition with plethora of intercrops, row ratios etc. across diverse agro-ecologies such as semi-arid black soils (Vertisols) of Vidarbha in Maharashtra and north Gujarat. However, it is always aimed to grow a suitable short duration intercrop in cotton for attaining maximum productivity per unit area in a sustainable manner with higher monetary returns apart from efficiently utilizing the rainwater and other inputs (Rao et al. 2003, Vittal et al., 2003). This information is lacking for most of the rainfed crops. The focused research on intercropping in different research centers of the All India Coordinated Research Project for Dryland Agriculture (AICRPDA) network aims to identify an efficient intercropping systems that would give higher productivity and stability of intercropping versus mono-cropping in agro-climatic regions...