



Contents lists available at [SciVerse ScienceDirect](http://SciVerse.Sciencedirect.com)

Field Crops Research

journal homepage: www.elsevier.com/locate/fcr



Conservation agriculture in the dry Mediterranean climate

Amir Kassam^{a,*}, Theodor Friedrich^b, Rolf Derpsch^c, Rabah Lahmar^d, Rachid Mrabet^e,
Gottlieb Basch^f, Emilio J. González-Sánchez^g, Rachid Serraj^h

^a School of Agriculture, Policy and Development, University of Reading, UK

^b Plant Production and Protection Division, Food and Agriculture Organization (FAO) of the United Nations, Rome, Italy

^c International Consultant for Conservation Agriculture/No-Till, Asunción, Paraguay

^d Systèmes de Culture Annuels – Centre de coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), France

^e Institut National de la Recherche Agronomique, Tangier, Morocco

^f Institute of Mediterranean Agricultural and Environmental Sciences (ICAAM), University of Evora, Portugal

^g Rural Engineering Department, University of Córdoba, Spain

^h International Centre for Agricultural Research in the Dry Area (ICARDA), Aleppo, Syria

ARTICLE INFO

Article history:

Received 26 July 2011

Received in revised form 4 January 2012

Accepted 22 February 2012

Keywords:

Carbon
Intensification
No-tillage
Mulch
Rotation
Climate change

ABSTRACT

The objective of this article is to review: (a) the principles that underpin conservation agriculture (CA) ecologically and operationally; (b) the potential benefits that can be harnessed through CA systems in the dry Mediterranean climate; (c) current status of adoption and spread of CA in the dry Mediterranean climate countries; and (d) opportunities for CA in the Central and West Asia and North Africa (CWANA) region. CA, comprising minimum mechanical soil disturbance and no-tillage seeding, organic mulch cover, and crop diversification is now practised on some 125 million ha, corresponding to about 9% of the global arable cropped land. The area under CA is spread across all continents and many agro-ecologies, including the dry Mediterranean climate. Empirical and scientific evidence is presented to show that significant productivity, economic, social and environmental benefits exist that can be harnessed through the adoption of CA in the dry Mediterranean climates, including those in the CWANA region. The benefits include: higher productivity and income; climate change adaptation and reduced vulnerability to the erratic rainfall distribution; and reduced greenhouse gas emissions. CA is now spread across several Mediterranean climate countries outside the Mediterranean basin particularly in South America, South Africa and Australia. In the CWANA region, CA is perceived to be a powerful tool of sustainable land management but it has not yet taken off in a serious manner except in Kazakhstan. Research on CA in the CWANA region has shown that there are opportunities for CA adoption in rainfed and irrigated farming systems involving arable and perennial crops as well as livestock.

© 2012 Published by Elsevier B.V.

1. Introduction

Globally, the dry Mediterranean climates occur in the subtropics and temperate regions of every continent, on their western sides between latitudes 30 and 45 degrees North and South, in addition to the countries of the Mediterranean Sea basin in Europe, North Africa and west Asia, and in Central Asia and the Caucasus. Outside the Mediterranean basin region, Mediterranean climates occur in south western South Africa, south western and south central Australia, central Chile, west central Argentina, north west Mexico, parts of the Pacific Northwest in North America including

Washington and Oregon, and the south west USA including California. The precipitation is received as rain or snow during the autumn, winter and spring period from October to May in the northern hemisphere and from April to November in the southern hemisphere, and can range from some 200 to 600 mm annually, corresponding to a reference average length of frost-free crop growing season of 90–150 days, with high precipitation variability within and between seasons (Kassam, 1988). In general, the dry Mediterranean climate located near the sea have relatively mild winter temperatures and hot summers (maritime climate); those located away from the sea within a larger land mass have severely cold winter temperatures and hot dry summers (continental climate). At higher altitudes and latitudes inland from the Mediterranean Sea, the severity of winter temperatures is increased but with moderate temperatures during the dry summer period. Thus, in the Mediterranean basin, there is a variety of climatic regimes owing to the complex configuration of seas and mountainous peninsulas in the 3000 km incursion into Central Asia and the Caucasus.

* Corresponding author at: 88 Gunnersbury Avenue, Ealing, London W5 4HA, UK.
Tel.: +44 2089933426.

E-mail addresses: kassamamir@aol.com (A. Kassam), Theodor.Friedrich@fao.org (T. Friedrich), rolf.derpsch@tigo.com.py (R. Derpsch), rabah.lahmar@cirad.fr (R. Lahmar), rachidmrabet@gmail.com (R. Mrabet), gb@uevora.pt (G. Basch), gonzalez@uco.es (E.J. González-Sánchez), r.serraj@cgiar.org (R. Serraj).