Proc. Natl. Acad. Sci., India, Sect. B Biol. Sci. (Jan–Mar 2016) 86(1):21–32
DOI 10.1007/s40011-014-0394-8

RESEARCH ARTICLE

# Fertilization and Crop Residue Addition Impacts on Yield Sustainability Under a Rainfed Maize–Wheat System in the Himalayas

**Ranjan Bhattacharyya · A. K. Pandey · K. A. Gopinath · B. L. Mina · J. K. Bisht · J. C. Bhatt**

Received: 30 August 2013 / Revised: 20 May 2014 / Accepted: 11 July 2014 / Published online: 2 September 2014


**Abstract** A 9-year old experiment was conducted at Almora, India to study the effects of mineral sources of nutrients in different combinations with or without crop residue or farmyard manure (FYM) addition on crop productivity under a rainfed maize–wheat system. Plots under 100 % nitrogen–phosphorus–potassium (NPK) + FYM had maximum mean maize (5.00 Mg $ha^{-1}$) and wheat (2.61 Mg $ha^{-1}$) yields that were generally significantly higher than yields observed under other treatments. Total soil organic carbon (C) increased in all treatments except with mineral fertilization and control plots. While NPK treated plots had significantly higher benefit:cost ratio than NPK + FYM plots, organic C content in the NPK treated plots decreased over the initial soil and FYM treated plots had better soil physical and chemical properties than NPK only. Thus, the study showed that although the combined 100 % NPK and FYM application had higher productivity of the maize–wheat system, the same is as remunerative as 50 % NPK + FYM, if the cost of FYM was considered. However, depending upon the resource availability, farmers can also apply Kudzu, maize stalk and wheat straw annually along with adjusted dose of NPK to a crop and full dose of NPK to the other crop as the alternate options.

**Keywords** Maize–wheat system · Crop residue addition · Yield sustainability · Carbon sequestration · Integrated nutrient management

## Introduction

In the Indian Himalayas, only about 10 % area is irrigated and rest 90 % is rainfed [1]. The productivity of rainfed crop is very low and is mainly attributed to the practice of growing long duration cultivars of the common crops (having low yield potentials) with minimal use of fertilizers. Results of a number of field experiments clearly indicated that with the adoption of modern, short duration, high yielding cultivars and with adequate input use, the yield of the rainfed crops could be increased to economically profitable level [2].

Maize–wheat system is one of the predominant cropping systems in the rainfed agriculture of the Indian Himalayas [3]. Maize–wheat is the third most important cropping systems after rice–wheat and rice–rice that contributes about 3 % in the Indian national food basket. It is an important system under highland mixed farming systems (that covers about 13 % of the land area) of south Asia