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On-Farm Evaluation of Land Treatments to Increase Infiltration and Crop Yield on a Shallow Vertic Soil

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Abstract: An on-farm experiment was conducted on a Vertic Inceptisol site with a 2% slope at Chevella watershed, Medak district (Andhra Pradesh), to compare the effect of three land treatments: (i) graded contour cultivation on 0.2% gradient (T_1), (ii) graded contour cultivation with furrows on 0.2% gradient (T_{2a} without ties during 1986 and T_{2b} with ties during 1987 and 1988) and (iii) up and down cultivation (T_3) on runoff, soil moisture and crop yields. The experiment had sorghum (Sorghum bicolor L.)/pigeonpea (Cajanus Cajan L.) intercrop during 1986 and sunflower (Helianthus Annuus L.) during 1987 and 1988.

In 1986, runoff was 4.3% of seasonal rainfall for T_1 and 3.1% for T_{2a} compared with 8% for T_3. In 1987 and 1988, the runoff amounts were ranked in the order $T_{2b} < T_1 < T_3$. Similar trends were observed for peak runoff rate and number of runoff events. Surprisingly, profile moisture in 1987 was higher in T_1 than in T_{2b}. This was probably due to the bypass flow of infiltrated water in T_{2b}. Sunflower yields during 1987 were in the order $T_1 > T_{2b} > T_3$. In 1988, sunflower failed in all the treatments due to extreme waterlogging conditions on the study site.

Based on circumstantial evidence of the higher potential for ground water recharge in contour-cultivated and tied-ridged fields, these treatments could be recommended in watersheds where farmers seek ways to improve water supplies for their wells. The contour cultivation treatment seems to be particularly suitable as it is inexpensive and improves crop yields in some years. Further investigations are warranted to determine the effect of tied ridging on profile moisture in shallow Vertic soils.

Introduction

Chevella watershed covering an area of 673 ha in the semi-arid black soil region of Medak district of Andhra-Pradesh, was selected by the Indian Council of Agricultural Research and the Government of India in 1983 for the development of improved dryland farming practices on a watershed basis. About 37% area of this watershed is occupied by Vertic

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soils (Anon., 1985), which have high clay contents, but are too shallow to be classified as Vertisols. India has over 40 million ha of Vertic soils, and there are also large areas in Africa and Australia (Smith et al, 1991). Vertic Ustropepts are one group of Vertic Inceptisols, often located on sloping pediments, and have also suffered moderate-to-severe erosion in the past. High runoff, high erosion, poor profile water-holding capacity and poor crop establishment and growth are the limitations to productivity in Vertic Ustropepts (Smith et al, 1991; Srivastava et al, 1988). Conservation and optimization of the use of rainwater is an important part of improved dryland farming practices in these soils. Given this premise, there is a need for an increased understanding of the effect of land and surface management practices on water conservation and plant productivity in Vertic Ustropepts.

Farmers in many parts of India generally orient the direction of cultivation and crop rows along the length of the field without considering the topography of the land. They are mostly concerned with convenience in the movement of traction animals and implements. Hence, cultivation and planting along the major slopes are commonly observed in farmers fields (Ranga Rao and Rama Mohan Rao, 1980), and this can cause considerable loss of water, soil and nutrients (Mittal et al, 1988). While contour cultivation and ridge-furrow cultivation are usually recommended for soil and water conservation on Vertic soils (Anon., 1981), these practices have not been widely tested on farmers' fields.

Since the environmental and management factors in farmers' fields vary frequently from those on research stations (Chambers and Ghildyal, 1985,), the conclusions drawn from research station studies are often not directly applicable to on-farm situations. Recognizing this point, a collaborative project was intiated in 1986 by Central Research Institute for Dryland Agriculture (CRIDA) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) to study the effect of different land treatments on soil moisture, runoff and crop yield under on-farm conditions on Vertic Ustropept at the Chevella watershed. The study site and treatments were chosen by a team of scientists from CRIDA and ICRISAT. This paper reports the major findings of this study.

Materials and Methods

Climate

The mean annual rainfall recorded at Jogipet (about 25 km from the study site) is 870 mm, but normally 90% of this is received between June 15 and October 15. The maximum temperature of 38.9°C is recorded during April, and the minimum temperature of 13.5°C is observed during December. Rainfall aberrations such as a delay in the onset of the monsoon, long gaps in rainfall in August, and early termination of the rainy season reduce the productivity of dryland crops of this region (Anon., 1985).

Experimental site

The experimental area was surveyed and a contour map prepared. The general slope of the land is 2%. The soil is a Vertic Ustropepts. The profile has clay at 0-40 cm depth (5-10% gravel) and gravelly clay loam with 25% gravel at 40-65 cm depth and weathered rock material at 65-100 cm depth (Table 1).

Experimental layout and observations

There were three land treatments: T_1-graded contour cultivation with 0.2% grade, T_{2a}-graded contour cultivation on 0.2% grade with furrows on grade at 1.2 m interval, and T_3-up and down cultivation. The treatment T_{2a}