Socioeconomics

Economic Impact of Improved Pearl Millet Production Technology in Resource-poor Rainfed Areas of Kurnool District of Andhra Pradesh

A Ramakrishna[1,*], **SP Wani**[1], **Ch Srinivasa Rao**[1], **G Tirupathi Reddy**[2] and **M Ramarao**[3] (1. ICRISAT, Patancheru 502 324, Andhra Pradesh, India; 2. Awakening People Action for Rural Development (APARD), Kurnool 518 002, Andhra Pradesh, India; 3. District Water Management Agency (DWMA), Kurnool 518 002, Andhra Pradesh, India)

*Corresponding author: A.Ramakrishna@cgriar.org

Introduction

Pearl millet (*Pennisetum glaucum*) is the most drought tolerant domesticated cereal, and is the fourth most important cereal food crop in India. Being an arid and semi-arid crop, it is traditionally a component of dryland cropping systems (Harinarayana 1987). Traditional farming practices include the use of locally adapted varieties with poor yield potential and little application of manures and chemical fertilizers. The production potential of pearl millet needs to be commercially exploited in such areas. Given quality seed, optimum amounts of fertilizer, and good cultural and water management practices, it is possible to increase millet productivity and attain stabilized yield levels.

The drought-prone districts of Andhra Pradesh, India include Kurnool, Mahbubnagar, Nalgonda, Anantapur and Prakasam and are characterized by low soil fertility, inappropriate soil and water management practices causing land degradation, lack of improved varieties, pest and disease incidence, declining land:man ratio, and resource-poor farmers, which contributes to the burgeoning problem of rural poverty. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the Government of Andhra Pradesh have initiated a project with the Andhra Pradesh Rural Livelihoods Programme (APRLP) to help reduce poverty through increased agricultural productivity and improved livelihood opportunities through technical backstopping and convergence through a consortium of institutions. Watersheds are used as an entry point for these activities.

Materials and Methods

Watersheds for undertaking on-farm research were selected in Karivemula and Devanakonda villages in Kurnool district, based on representative typology of the watershed, extent of rainfed area, current crop productivity and willingness of community to participate in on-farm research activities. The strategy adopted was a knowledge-based, bottom-up and participatory approach, which involved close interactions with the project implementation agencies (PIAs) and farmers. The detailed socioeconomic surveys using participatory rural appraisal (PRA) in each watershed helped us to understand the constraints to reduced crop productivity. From this analysis, we were able to better understand how to achieve increased productivity from the farmer's perspective.

Soil samples were collected from thirty farmers' fields in Karivemula and Devanakonda watersheds of Kurnool district on a toposequence and were analyzed for physical and biological parameters and various nutrients. The results indicated that all the fields were low in N (599 mg kg^{-1} soil), low to medium in available P (9.8 mg kg^{-1} soil) (Olsen's P), high in exchangeable K (133 mg kg^{-1} soil), and low in available Zn (0.4 mg kg^{-1} soil), S (3.2 mg kg^{-1} soil) and B (0.3 mg kg^{-1} soil). The information from soil analysis along with historical rainfall and minimum and maximum temperature data enabled us to calculate the length of the growing period (LGP). This critical information assisted in identifying better options to improve yield levels and for sustaining natural resources.

Five on-farm trials in Karivemula as well as in Devanakonda were conducted during the rainy season in 2003 to demonstrate the beneficial effects of improved production technologies in pearl millet. The package included improved cultivar (ICTP 8203), seed rate of 4.0 kg ha^{-1}, seed treatment with thiram (3 g kg^{-1} seed) and fertilizer dose of 60 kg N ha^{-1} and 30 kg P_2O_5 ha^{-1}. Full application of P and 50% of N were applied as a basal dose and the remaining 50% of N as topdressing at 30 days after sowing. Basal application of micronutrients included a mixture of 5 kg borax (0.5 kg B) ha^{-1}, 50 kg zinc sulfate (10 kg Zn) ha^{-1} and 200 kg gypsum (30 kg S) ha^{-1}. Two intercultivations at 25 and 50 days after sowing were used to control weeds. The crop was free from pests and diseases. Improved production technology was compared with the farmers' method in an area of 1000 m^2 in each of the farmers' fields. The farmers' method included a seed rate of 3 kg ha^{-1} and a fertilizer dose of 32 kg N ha^{-1} and 23 kg P_2O_5 ha^{-1}. Full application of P and 9 kg N ha^{-1} were applied as basal and 23 kg N ha^{-1} applied as topdressing at the panicle initiation stage. The seasonal rainfall was 307 mm in Karivemula and 470 mm in Devanakonda, much below the previous normal rainfall (572 mm).

Results and Discussion

The improved production technologies gave higher yields in both locations and recorded a mean grain yield of 2.11 t ha^{-1} which was 164% higher than that obtained with farmers' practice (0.80 t ha^{-1}) (Table 1). In addition to increased grain yields, improved technology also resulted in a higher fodder yield of 1.81 t ha^{-1}. Fodder yield is very important in this area, as the major crops grown are groundnut (*Arachis hypogaea*), tomato (*Lycopersicon esculentum*), sunflower (*Helianthus annuus*) and castor (*Ricinis communis*). Only groundnut is used as a source of fodder. Severe scarcity of fodder is being experienced in Kurnool district due to continuous droughts, which is leading to yearly reductions in cattle population.

The increased grain and fodder yields with improved production practice were due mainly to higher plant populations, increased total dry matter, increased heads weight, higher threshing percentage, higher 100-grain mass and higher harvest index (Table 2). Traditional dryland cropping systems are characterized by low risk and low yield. It must be recognized that low risk will continue to be the guiding principle in view of socio-economic conditions of dryland farmers. The problem would be how to combine low risk and high yield. For realizing full yield potential, optimum plant population per unit area is very important. Selecting suitable variety will not only help increase production of a single crop but also help increase cropping intensity. Plant population depends not only on seeding rate but also on the time and method of sowing which are low monetary inputs. The rainy season crops should be planted with the first "soaking" rains to enable the crops to make use of early season rains which should allow them to complete their life cycle before the cessation of rains. Split application of fertilizers in relation to crop needs and moisture availability also helps increase fertilizer-use efficiency. Robust plants with yield contributing factors like higher threshing percentage, bold grain and uniform maturity are encouraged. Yield increases in response to balanced fertilization have been reported by Bationo et al. (1993).

The economic viability of improved technologies over traditional farmers' practice was calculated using prevailing prices of input and output costs. The additional cost of US$29 ha^{-1} (Table 1) incurred in the improved technology as compared to farmers' practice was mainly due to balanced fertilization (micronutrients and additional N and P) and one additional weeding by intercultivation. However, the improved technology resulted in increased mean income of US$146 with a cost-benefit ratio of 2.6 (Table 1). This additional income could substantially

Table 1. Yields and economics of pearl millet in ten on-farm trials conducted at Karivemula and Devanakonda watersheds in Kurnool district of Andhra Pradesh, India.

Cultivation method	Grain yield (t ha^{-1})	Fodder yield (t ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net return (Rs ha^{-1})	Benefit-cost ratio
Improved production technology	2.11	1.81	3500 (78)[1]	9148 (203)	2.6
Farmers' practice	0.80	1.13	2200 (49)	2581 (57)	1.2
SE±	0.14	0.18	91	764	
CV (%)	21.0	27.2	7.1	29.1	

1. Figures in parenthesis are in US$.

Table 2. Yield components of pearl millet in ten on-farm trials conducted at Karivemula and Devanakonda watersheds in Kurnool district of Andhra Pradesh, India.

Cultivation method	Plant population (number ha^{-1})	Total dry matter (t ha^{-1})	Heads weight (t ha^{-1})	Threshing (%)	100-grain mass (g)	Harvest index
Improved production technology	129212	4.34	2.53	83	1.07	0.48
Farmers' practice	127282	2.17	1.04	76	0.64	0.37
SE±	3335	0.32	0.16	0.72	0.10	0.02
CV (%)	5.8	21.7	19.8	2.0	25.0	9.9

benefit resource-poor farmers and improve their livelihoods in the dry regions of Kurnool district. Significant increases in grain yields of sorghum (*Sorghum bicolor*) by 120% and maize (*Zea mays*) by 76% were observed due to balanced fertilization (TJ Rego, ICRISAT, personal communication). Arromratana et al. (1993) reported that applications of micronutrients like gypsum and B significantly increased test weight. Similar results were also reported by Joshi (1997) and the response to micronutrients was more evident during a drought year than in normal years. Rajat De and Gautam (1987) reported that with scientific management practices, crop yields could be increased at least three-fold. The results from our study clearly bring out the potential benefits of improved production technology in enhancing pearl millet yields and net returns in the dry ecoregions of Andhra Pradesh.

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