Agronomy

Performance of Pearl Millet Variety LCIC-MVI in a Pearl Millet - Cowpea-based System in Nigeria

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Introduction

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is a very important cereal crop in Nigeria; grown on 5.2 m hectares with an annual production of 4.62 million tons of grain. Pearl millet occupies about 32% of the total area sown to cereals in Nigeria and accounts for 25% of the total cereal production in that country. The pearl millet in Nigeria represents more than a quarter of the area under this crop in Africa. These data are based on 3-year averages from 1992 to 1994 (Food and Agriculture Organization of the United Nations (FAO), and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) 1996). Improvement in pearl millet yields in developing countries, mainly in India, have occurred largely due to the adoption of improved varieties (both hybrid and open-pollinated) and only a little to the limited investments in fertility maintenance. Because of low sowing rates (4 to 5 kg ha^{-1}) and high multiplication rates (400 to 500 fold per generation), pearl millet improved varieties have been adopted fairly widely in India even by subsistence farmers. Contrary to those in Asia, most farmers in Africa still grow traditional pearl millet varieties. After 3 years of on-farm testing, farmers preferred an ICRISAT - NARS bred pearl millet variety, LCIC-MVI (popularly known as SOSAT-C88), released in Nigeria for general cultivation on 13 January 2000.

In the Sudanian Savanna Zone of northern Nigeria millet - cowpea intercropping is a predominant mixture present in some 22% of the Fields under cultivation (Henriet et al. 1997). The advantages of intercropping includes better use of available resources, yield stability, reduced crop losses due to weeds, pests and diseases, soil fertility maintenance due to reduced erosion and nutrient leaching, and balanced distribution of labor requirements (Norman 1974; Steiner 1982). These low-input traditional cropping systems have evolved over centuries of experience and are quite sustainable (Henriet et al. 1997), but low-yielding.

In this contribution, we report the performance of a new pearl millet cultivar sown with cowpea [*Vigna unguiculata* (L.) Walp.] in an improved pearl millet-cowpea system, jointly studied in on-farm trials, by ICRISAT, the Kano Agricultural and Rural Development Authority (KNARDA), Lake Chad Research Institute (LCRI), and farmers.

Materials and methods

The pearl millet-cowpea cropping system trial was conducted at four locations in Kano State during 1999. The locations were Gargai (11°53' N, 8°I4' E, Sudanian Zone), Gabasawa (12° 11' N, 8°54' E, Sahelian Zone), Panda (11°31' N, 8°04' E, Sudanian Zone), and Shiddar (12°25' N, 8°31' E, Sahelian Zone). At all four locations, rainy months are from June to October with peak rainfall in August. The rainfall during the growing season was 910 mm at Gargai, 900 mm at Panda, and 710 mm at both Gabasawa and Shiddar. The trial consisted of two treatments, with eight replications (farms as replicates) and sown in randomized complete-block design. Pearl millet varieties (both improved and local), and an improved cowpea cultivar were sown between 26 June and 29 July depending on the rains and location. Local cowpea cultivars are normally sown late and farmers sowed them until 28 August.

The First treatment was a traditional farming system commonly practiced by farmers in their various regions. Farmers sowed pearl millet and cowpea in 1:1 ratio (200 m^2 : 200 m^2) at Gabasawa, and Shiddar, and in 4:1 ratio (320 m^2 : 80 m^2) at Panda and Gargai. The second treatment was an improved cropping system of two rows of pearl millet (LCIC-MVI) to four rows of cowpea (IT 90K 277-2). The improved cropping system had 160 m^2 under pearl millet and 240 m^2 under cowpea. In the improved system, fertilizer (NPK 20:10:10) was applied at 200 kg ha^{-1} to pearl millet, 3 weeks after the seed was sown on the ridges. The row-to-row spacing was 100 cm. The plant-to-plant spacing for pearl millet was 50 cm, while for cowpea it was 25 cm. Data were recorded on grain yield, stover yield, and time to 50% flowering for both pearl millet and cowpea. Additional data on plant height and threshing percentage were recorded from pearl millet. Grain yield and stover yield data were converted into per ha before analysis.

Results and discussion

The results of the pearl millet/cowpea-based trial are presented in Tables 1 and 2. The pearl millet grain and stover yields were signiFicantly higher in the improved system than in the traditional system at each of the four locations. Based on means over four locations, the

Table 1. Performance data of improved pearl millet open-pollinated cv LCIC-MV1 in pearl millet-cowpea intercropping trial at individual locations and averaged over four locations in Nigeria, 1999

Traits	Gargai	Gebassawa	Panda	Shiddar	Mean
Grain yield (t ha^{-1})					
Improved system	1.54	1.94	1.31	2.17	1.74
Traditional system	0.41	1.47	0.61	1.23	0.93
LSD (*P*<0.05)	0.76	0.19	0.39	0.55	0.22
CV(%)	66.00	9.30	34.60	27.40	-
Stover yield (t ha^{-1})					
Improved system	3.56	4.73	2.78	3.20	3.57
Traditional system	1.98	3.89	1.61	2.22	2.43
LSD (*P*<0.05)	0.58	0.68	0.66	0.34	0.25
CV(%)	17.60	13.40	25.20	10.50	-
Threshing Percentage (%)					
Improved system	67.8	79.3	67.1	77.5	72.9
Traditional system	67.5	77.7	65.7	62.5	68.4
LSD (P<0.05)	4.0	2.2	4.5	10.9	2.8
CV(%)	5.1	2.4	5.8	13.2	-
Time to 50% flowering (days)					
Improved system	55.5	52.6	63.1	61.6	58.2
Traditional system	44.6	51.0	73.0	64.9	58.4
LSD (*P*<0.05)	6.8	10.9	8.6	3.9	3.5
CV (%)	11.5	17.9	10.7	5.2	-
Plant height (m)					
Improved system	1.46	2.02	2.08	1.90	1.86
Traditional system	1.57	2.51	2.47	2.30	2.21
LSD (*P*<0.05)	0.04	0.07	0.45	0.22	0.11
CV (%)	2.50	2.60	16.70	8.70	-

Table 2. Performance data of improved cowpea cv IT90K 277-2 in pearl millet-cowpea intercropping trial for individual locations and averaged over four locations in Nigeria, 1999

Traits	Gargai	Gebassawa	Panda	Shiddar	Mean
Grain yield (t ha^{-1})					
Improved system	1.54	1.94	1.31	2.17	1.74
Improved system	0.40	0.99	0.31	0.81	0.63
Traditional system	0.36	0.90	0.34	0.04	0.41
LSD (*P*<0.05)	0.19	0.32	0.13	0.26	0.10
CV (%)	38.30	28.00	34.30	47.80	-
Stover yield (t ha^{-1})					
Improved system	0.58	1.16	NR[1]	NR	0.87
Traditional system	0.32	1.18	NR	NR	0.75
LSD (*P*<0.05)	0.22	0.38	-	-	0.20
CV (%)	38.10	26.50	-	-	-
Time to 50% flowering (days)					
Improved system	42.4	44.1	37.7	NR	41.4
Traditional system	69.4	56.8	64.9	NR	63.7
LSD (*P*<0.05)	15.0	14.6	6.4	-	6.0
CV (%)	20.9	23.6	10.6	-	-

1.NR = Not recorded.

improved system produced almost double the grain yield (1.74 t vs 0.93 t ha^{-1}) of pearl millet and 47% more stover (3.57 t vs 2.43 t ha^{-1}) as compared to traditional systems. The cost of 200 kg fertilizer was ₦ 5200 and the cost of an application of fertilizer was ₦ 600 ha^{-1}. The value of extra grain produced (0.81 t ha^{-1}) was ₦ 9720 ha^{-1}. Considering only pearl millet grain yield, there was a net profit of ₦ 3920 ha^{-1}, assuming the cost of all other operations was equal. The local pearl millet variety was taller than LCIC-MV1 and both varieties took about 58 days to reach 50% flowering. Cowpea grain yields under traditional and improved systems were similar at each location except Shiddar.

Field days were organized at all the locations. Of the farmers interviewed 70% preferred 2 rows of pearl millet or sorghum with 2 rows of cowpea. All the participating farmers are smallholder farmers and like to secure their food first. Farmers also prefer to intercrop cereals with groundnut, or cereals with cereals to monocropping.

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Continuous Cropping and Fertilization Effects on Crop Yields in a Long-term Fertilizer Experiment

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The long-term effect of manures and fertilizers on the yields of finger millet [*Eleusine coracana* (L.) Gaertn.], maize (*Zea mays* L.), cowpea [*Vigna ungiculata* (L.) Walp.] in a rotation have been under study on a Vertic Ustropept soil in Coimbatore, India since 1972. This area enjoys a semi-arid tropical climate with mean temperatures of 31 °C (May-June) to 21°C (December-January). The experiment has ten treatments, replicated four times. The grain yields of finger millet and maize over 25 years are presented in Table 1. The continuous application of graded doses of NPK fertilizers significantly increased the grain

Table 1. Grain yield (t ha^{-1}) of finger millet and maize crops over 25 years in a long-term fertilizer experiment, Tamil Nadu Agricultural University (TNAU), Coimbatore, India, 1972-97

	Finger millet						Maize					
Treatments[1]	1972	1977	1982	1987	1992	1997	1972	1980	1982	1987	1992	1997
50% NPK	2.4	2.3	2.3	2.9	2.5	3.2	2.2	1.7	1.3	3.0	2.7	3.4
100% NPK	2.7	2.9	2.4	3.9	3.2	3.4	2.7	2.1	1.4	3.2	3.1	3.4
150% NPK	3.1	3.2	2.5	3.7	3.5	3.5	2.6	2.3	1.8	3.6	3.1	3.7
100%NPK + HW	3.1	3.1	2.0	3.8	3.2	2.8	2.6	2.4	1.6	3.2	2.9	3.0
100% NP	3.0	2.8	2.0	3.2	3.1	3.4	2.5	2.1	1.3	2.8	3.1	3.7
100% N	2.1	0.6	0.6	0.9	0.9	2.8	0.9	0.5	0.4	0.5	0.9	1.9
100%NPK + FYM	3.0	3.4	2.3	4.8	3.9	3.6	3.0	3.0	1.6	3.7	3.4	3.8
100% NPK (-S)	3.0	2.9	2.1	3.4	3.2	3.5	2.7	2.3	1.4	3.2	2.8	3.0
Control	1.6	0.5	0.4	0.9	0.9	2.3	0.5	0.5	0.4	0.4	0.7	1.9
CD (P<0.05)	0.5	0.2	0.4	0.6	0.2	0.7	0.6	0.3	0.2	0.6	0.2	0.3

1. HW = hand weeding; FYM = farmyard manure; S = sulfur
100% NPK = 90 kg N : 45 kg P_2O_5: 17.5 kg K,0 ha^{-1} for finger millet
100% NPK = 135 kg N : 67,5 kg P_2O_5: 35 kg K_2O ha^{-1} for maize.