

RESEARCH ON PRODUCTIVITY AND YIELD QUALITY OF MAIZE AND COWPEA INTERCROPPING IN THE ORGANIC AGRICULTURE SYSTEM

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Abstract

The paper researches the productivity and yield quality of maize and cowpea intercropping in order to evaluate their adaptability to the natural conditions of South Romania and to organic cultivation.

The experiment was carried out in the 2007-2009 period, in Moara Domneasca Experimental Field, on reddish preluvosoil, in randomized variants, in 4 replications. The seeds used for experiments were organic. Maize and cowpea were sown in alternating rows (1 row of maize, 1 row of cowpea), in 70 cm distance between maize rows and 35 cm distance between rows of cowpea and rows of maize, at a 5 cm depth. Maize crop had a density of 5 plants/m² and cowpea crop of 12 plants/m². There were determined the productivity compounds, land equivalent ratio and yields.

The average grain yield for maize in monoculture was of 35.51 q/ha and in intercropping with cowpea of 33.56 q grains/ha. In monoculture, the average cowpea yield was of 18.38 q/ha and in intercropping with maize 8.03 q/ha, were harvested.

In terms of chemical composition, maize intercropped with cowpea contains 9.35% proteins, 4.79% fats and 68.94% starch. Cowpea seeds had 24.69% protein, 0.87% fats and 40.15% starch.

INTRODUCTION

Nowadays, in the developed regions of the world, conventional agriculture, which is more and more monoculture or pure crop-oriented, modifies landscapes and hurts the ecosystems, including biodiversity.

Thus, at both world and European levels, a new concern has occurred, related to the connection between agricultural practices, environmental problems and the long-term stability of agricultural production systems. The organic agriculture system must be regarded as an integrant part of the sustainable development strategies and as a viable alternative to conventional agriculture.

One of the non-polluting agricultural practices, which also represent a way of increasing crop diversity, would be the introduction of intercropping in the organic agriculture system [1].

Cereals-grain legumes intercropping play an important role in subsistence food production in both developed and developing countries, especially in situations of limited water resources [3]. Plant growth factors such as light, water and nutrients are more efficient utilized and converted to crop biomass by intercropping. Intercropping cereals and grain legumes can be adequate for both organic and conventional farmers because grain legumes such as cowpea are richer in protein compared to cereals.

MATERIAL AND METHODS

Research was carried out in the years 2007-2009 in Moara Domneasca Experimental Field and its main purpose was to study the productivity and yield quality of maize and cowpea in intercropping, in order to know their adaptability to reddish preluvosoil area pedoclimatic conditions of the central part of Romanian Plain and in the organic agriculture system.

In this experiment, a program of phenological observations and biometrical measurements was developed and a series of parameters were followed, such as: agronomical parameters (productivity compounds and seed yields), competition parameters (land equivalent ratio) and quality parameters (protein, fat and starch contents).

The seeds used for experiments were organic. Maize and cowpea were sown in alternating rows (1 row of maize, 1 row of cowpea), in 70 cm distance between maize rows and 35 cm distance between rows of cowpea and rows of maize, at a 5 cm depth. Maize crop had a density of 5 plants/m² and cowpea crop of 12 plants/m² [2]. The spatial distribution was as shown below (Figure 1).

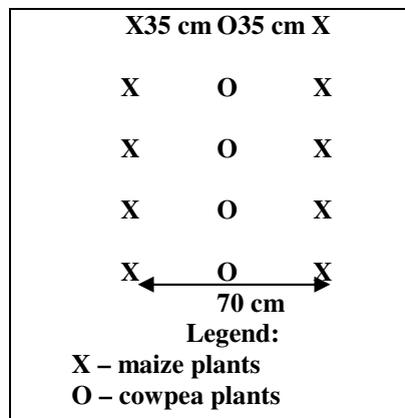


Fig. 1. Spatial distribution for maize–cowpea intercropping

RESULTS AND DISCUSSION

A. Results for maize. As far as the productivity compounds are concerned, maize from monoculture formed cobs of 20.5 cm long, with an average of 14.8 rows/cob, 41 grains/row and 597 grains/cob. Grains weight/cob was of 169.6 g, grain productivity of 79.2% and TGW of 284.2 g.

On 3 years average, maize intercropped with cowpea formed cobs of 20.2 cm long, 14.6 grain rows/cob, 39.8 grains/row and an average of 584.3 grains/cob. Grains weight/cob was 164.9 g, grain productivity of 78.7% and TGW was 282.4 g (table 1).

Table 1

Productivity compounds at maize, in monoculture and in intercropping
(Moara Domnească Experimental Field, 2007-2009)

Productivity compounds	Maize monoculture	Maize-cowpea intercropping
	Average 2007-2009	
Cob length (cm)	20.5	20.2
Number of rows/cob	14.8	14.6
Number of grains/cob	597.1	584.3
Number of grains/row	41.3	39.8
Cob weight (g)	214.1	209.2
Grain weight/cob (g)	169.6	164.9
Grain productivity (%)	79.2	78.7
TGW (g)	284.2	282.4

In terms of chemical composition, maize grains from monoculture had the following content: 12.71% moisture, 10.13% proteins, 5.30% fats and 66.94% starch. When intercropped with cowpea, maize grains had a content of 12.8% moisture, 9.35% proteins, 4.79% fats and 68.94% starch (Table 2).

Table 2

Chemical composition of maize and cowpea seeds, in monoculture and in intercropping (Moara Domnească Experimental Field, 2007-2009)

Type of culture	Moisture (%)	Protein (% d.m.)	Fat (% d.m.)	Starch (%)
Maize (monoculture)	12.71	10.13	5.30	66.94
Cowpea (monoculture)	11.05	25.50	1.09	42.06
Maize intercropped with cowpea	12.80	9.35	4.79	68.94
Cowpea intercropped with maize	10.78	24.69	0.87	40.15

Based on productivity compounds and sowing density, there were determined the yields, both for maize grown in monoculture and in intercropping with cowpea. In monoculture, maize yield was in average of 35.51 q/ha. Compared with the control, maize yield in intercropping was 1.95 q/ha less, i.e. of 33.56 q/ha (Figure 2).

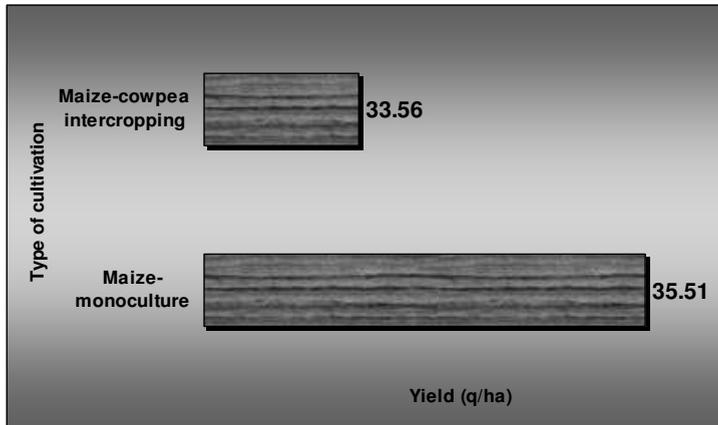


Fig. 2. Average maize yields, in monoculture and in intercropping with cowpea (Moara Domnească Experimental Field, 2007-2009)

B. Results for cowpea. In terms of productivity compounds, cowpea plants from monoculture had 49.0 cm height, formed on average 9.3 pods/plant, 76.6 grains/plant, 8 grains/pod, grain weight/plant was 8.0 g and TGW was 119.8 g. By comparison, in intercropping with maize, there was a competition for light, water and nutrients, so cowpea plants had on average a 47.3 cm height, formed only 7.5 pods/plant, 59.0 grains/plant, 7.9 grains/pod, grains weight/plant was 6.5 g and TGW was 113.2 g (Table 3).

Table 3
Productivity compounds at cowpea, in monoculture and in intercropping with maize (Moara Domnească Experimental Field, 2007-2009)

Productivity compounds	Cowpea monoculture	Maize-cowpea intercropping
	Average 2007-2009	
Plant height (cm)	49.1	47.3
Number of pods/plant	9.3	7.5
Number of grains/plant	76.6	59.0
Number of grains/pod	8.0	7.9
Grains weight/plant (g)	7.2	6.5
TGW (g)	119.8	113.2

During the 3 experimental years, in monoculture, there were harvested 18.38 q grains/ha, and in intercropping with maize, cowpea yield was 8.03 q/ha, 10.35 q/ha less than at the control (Figure 3).

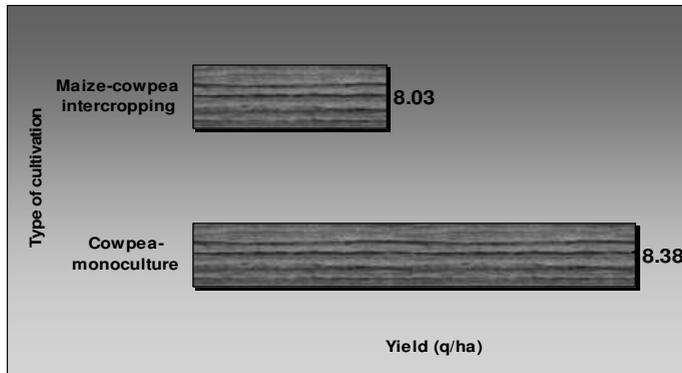


Fig. 3. Average cowpea yields in monoculture and in intercropping with maize (Moara Domneasă Experimental Field, 2007-2009)

For cowpea in monoculture, the moisture content was of 11.05% and in intercropping with maize average was of 10.78%. The protein content was 25.5% in monoculture and 24.69% in intercropping. In monoculture, the cowpea seeds contain 1.09% fats and 42.06% starch and in intercropping with maize, fat content was 0.87% and starch was 40.15% (Table 2). For maize-cowpea intercropping, the protein yield was of 5.87 q/ha (Table 4).

Table 4

Protein yields of maize and cowpea, in monoculture and in intercropping (Moara Domneasă Experimental Field, 2009)

Type of crop	Seed yield (q/ha)		Total yield (q/ha)	Protein yield (q/ha)		Total protein yield (q/ha)
	Maize	Cowpea		Maize	Cowpea	
Maize (monoculture)	36.22	-	36.22	3.66	-	3.66
Cowpea (monoculture)	-	24.63	24.63	-	6.28	6.28
Maize-cowpea	33.34	11.19	44.53	3.11	2.76	5.87

The partial and total land equivalent ratio (LER) was also determined during the research. Thus, in the 2007-2009 period, partial LER ranged between 0.43 for cowpea and 0.94 for maize. The total LER was of 1.37, which means that there is a

real advantage of intercropping maize with cowpea compared to monoculture. This value means that an area planted as monoculture would require 37% more land to produce the same yield as in intercropping (Table 5).

Table 5

Land equivalent ratio for maize-cowpea intercropping
(Moara Domneasca Experimental Field, 2007-2009)

Total LER	Type of crop	Yields in intercropping (q/ha)	Yields in monoculture (q/ha)	Partial LER
	Maize	33.56	35.51	0.94
	Cowpea	8.03	18.38	0.43
	-	-	-	1.37

CONCLUSIONS

1. The maize plants from intercropping behaved almost like the ones from monoculture. This means that there wasn't a real competition for light, water and nutrients between maize and cowpea plants.
2. The average maize grain yield in monoculture was 35.51 q/ha. In intercropping with cowpea, maize yield was 1.95 q/ha lower than the control, i.e. 33.56 q/ha.
3. When intercropped with cowpea, maize grains contain 12.8% moisture, 9.35% proteins, 4.79% fats and 68.94% starch.
4. Cowpea plants from monoculture developed better than in intercropping. This means that cowpea compete with maize for water, nutrients and light.
5. When grown in monoculture, cowpea plants produced 18.38 q/ha and in intercropping with maize, the yield was 10.35 q/ha lower than in monoculture, respectively 8.03 q/ha.
6. Cowpea seeds from intercropping contain 10.78% moisture, 24.69% proteins, 0.87% fats and 40.15% starch.
7. For maize-cowpea intercropping the protein yield/ha was 5.87 q/ha.
8. The total LER for maize-cowpea intercropping was 1.37, which means that there is a real advantage of intercropping maize with cowpea as compared to monoculture. This value means that an area planted as monoculture would require 37% more land to produce the same yield as in intercropping.

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