ABSTRACT

The sorghum culture expanded very quickly after 1950, at the same time with the growth of hybrids with great productivity and the possibility of harvesting using harvesters. The surface of the sorghum for seed could grow by expanding to the alkaline soils less favorable for corn. The sorghum could be a solution for the arid areas in Romania, as it can withstand the high temperatures during the germination-vegetation period.

The sorghum has the same varied usages as the corn. Hundreds of millions of people in Africa, China and India eat bread made of sorghum. Afterwards it is used as concentrated bait especially for birds and prime matter for the alcohol and beer industry.

Syrup with 55-60 % sugar is extracted from the sorghum's body, used in pastry and the alcohol industry. The sugared sorghum is used as green bait, concentrated and pickled.

The climatic evolution towards heating and aridization for the 2001-2005 period of time in the Balkan area, where Romania is also found, compels to a reconsideration of the sorghum as: alimentary cereal (beads used in the formula for composite flours destined for gluteic and agluteic panification, the sweet juice extracted from the body, used for making syrup, vinegar and other alimentary products), fodder plant (under the shape of green mass, hay, silo) and technical plant (stationary and textile celluloses, plastic material), the industry of construction materials and the handicraft industry (brushes of domestic and industrial use, brooms, nettings).

The first surfaces in Romania cultured with sorghum hybrids for beads, imported from the USA, were registered in the year 1960.

The average productions of high beads, obtained in unirrigated culture during the years 1961-1965, and the inconvenience of poor adaptation of the hybrids from the USA to the conditions in Romania and the late maturing have determined the including of sorghum (1958) with corn in an inland improvement program at the recently established I.C.C.P.T. Fundulea. The main objectives that have configured the improvement thematic, from the beginning, were precocizing, improving production capacity, of the tolerance to the soll's alkalinity and salinity, improving tolerance to aphids' attacks and improving the quality of the beads and of the rest of the plant (reducing the tannin content at the same time with increasing the content in protein, starch, bead oil and reducing the content of hydrocyanic acid and tannin in the green plant).

Sorghum, with tropical origin (Africa) is cropped especially in the regions with warm climate, but temperate continental, particularly the fodder sorghum.

The economic and fodder value of the sorghum comes from the following characteristics:

- the sorghum beads are used directly in the nourishment of people in some areas in Africa and Asia, and in the industry for extracting starch and alcohol;

- with a nutritional value close to that of corn, the sorghum beads have a wide use in the nourishment of taurin, for gaining weight, and of birds;

- the sorghum hay is superior in quality compared to the corn hay, because it contains large quantities of calcium, phosphorus and carotene salts;

- as silo, the sorghum has the same value as the silo corn and it becomes silo very easily due to the high content of carbon hydrates;

- when they are young, the sorghum plants contain the cyanogen glycoside called "durrhina"; through hydrolysis and contact with the emulsion enzyme in the animals' stomachs, it dissolves and forms the cyanhydric acid. This toxic substance is favored by the age of the plants, drought, low temperatures, grassing, excessive fertilizing with nitrogen, irrigation;

- the lethal dosage of cyanhydric acid is 1mg/kg live weight for taurin and 0.1mg/kg live weight for sheep. From the sorghum species, the sugared sorghum is not toxic and it can be eaten by animals.

The doctoral thesis is structured in six chapters and it is completed with conclusions and a bibliographic list.

Part I- the documentary study, encloses two chapters.

The first chapter of the thesis deals with the importance, origin, spreading and the harvesting technology for sorghum. The importance of the sorghum is especially highlighted for providing for the nutritional need of the animals, under the shape of concentrate forage, juicy and siloed. Moreover, the possibility of producing sorghum, using it as prime matter for making syrup, starch, glucose, beer and biogas are dawning.

Sorghum is important for valuing the marginal soils (with poor fertility, exposed to erosion, with salts, sandy and with high acidity). Aspects referring the origin of sorghum are also mentioned, botanical classification and spreading worldwide and in Romania, and the harvesting technology.

Globally, the surfaces cropped with sorghum are of 42.63 hectares, especially in Africa, North and Central America and Asia.

In our country, surfaces cropped with sorghum have diminished over the 1994 - 1999 period of time, from 7.6 thousand hectares to 1.7 thousand hectares, and over the 2001-2006 period of time, they have decreased from 6.2 thousand hectares to 0.7 thousand hectares.

In *the second chapter,* we find mentioning of the current research level in Romania and abroad, referring to the request for sorghum compared to the vegetation factors, cropping technologies, spreading, improvement, conserving and usage.

Part II- contributions to writing the thesis; it is represented by four chapters and completed with conclusions, recommendations and a bibliographic list.

The third chapter mentions the research objectives, research method and the biological material used. The following have been analyzed: the influence of fertilizing with organic and mineral fertilizers on the sorghum production for grains and on sorghum for silo, the influence of fertilizing over the production quality, on the sorghum for grains and silo, and the influence of fertilizing with organic and mineral fertilizers on the nutritional and energy value for sorghum for grains and silo.

The experience was organized at Ezareni farm, within the didactic resort of U.S.A.M.V. Iasi, displayed based on the method of subdivided parcels, with two factors (***Fundulea 21*** hybrids, ***Tinca*** and ***Fundulea 32*** and organic and mineral dressing), in three repetitions.

Usual experimental techniques were used for the quality analysis of the plants and soll, expressing production results and analysis.

In *chapter four* we find a characterization of the natural frame of the area and of the climatic and soil conditions, at the Ezareni farm, data received from the Miroslava Weather Station. We find descriptions of aspects of geology, lytology, geomorphology, hydrography, hydrology, light, nebulosity and soil.

The climadiagram over the experimental years shows that there were periods of drought registered in April-June of 2003, May- June 2004, November 2005-2006. Precipitation fallen has had an irregular character; there were periods with large quantity of precipitation registered, favoring surface leaks, aspect with an unfavorable influence over the growth of vegetation.

Chapter five encloses the largest part of the doctoral thesis, addressing the influence of fertilizing with organic and mineral fertilizers, over production of sorghum for grains and sorghum for silos.

Regarding the sorghum for grains, we find mentioning of the influence of fertilization over production of the three experimental hybrids, between 2003-2007. The highest average production was obtained for the ***Fundulea 32*** hybrid (4.66-9.66 t/ha DM), compared to the ***Tinca*** hybrid (4.38-6.70 t/ha DM) and the ***Fundulea*** 21 hybrid (3.54-6.12 t/ha DM).

Fertilizing with bovine manure has led to larger production, compared to the ***Fundulea 21***

hybrid, of 0.50-0.58 t/ha DM for the ***Tinca*** hybrid, and 0.66-0.88 t/ha DM for the ***Fundulea 32*** hybrid; fertilizing with mineral fertilizers contributed to achieving differences in production for

the ***Fundulea 21*** hybrid of 0.68-0.92 t/ha DM for ***Tinca*** and of 0.68-0.92 t/ha DM for the ***Fundulea 32*** hybrid; fertilizing with combined bovine manure 20-30 t/ha+$N_{65}P_{50}$ led to the largest production obtained: 5.80-6.12 t/ha for the ***Fundulea 21*** hybrid, 6.40-6.70 t/ha for ***Tinca*** and 6.78-6.96 t/ha for the ***Fundulea 32*** hybrid, with production increases, compared to the ***Fundulea 21*** hybrid of 9-10 % for the ***Tinca*** hybrid and 14-17 % for the **Fundulea 32** hybrid.

For the sorghum for silo, the average productions of the three hybrids were close: 8.18-11.48 t/ha for the ***Fundulea 21*** hybrid; 7.62-11.16 t/ha for the ***Tinca*** hybrid and 8.48-1.70 t/ha for the ***Fundulea 32*** hybrid. Fertilizing with 20-30 t/ha bovine manure favored production increases, compared to the control value, of 22-25 % for the ***Fundulea 21*** hybrid; 24-32 % for the ***Tinca*** hybrid and 18- 22 for the ***Fundulea 32*** hybrid.

Fertilizing with 20-30 t/ha+$N_{65}P_{50}$ favored obtaining production increases of 33-40 % for the ***Fundulea 21*** hybrid, 42- 46 % for the ***Tinca*** hybrid and 33-38 % for the ***Fundulea 32*** hybrid.

The experimental hybrids and fertilizing them has influenced the quality of the forage obtained.

For the sorghum for grains, the content in dry substance was determined, in raw protein, content in fat, celluloses, ashes and extractive substances free of nitrate.

In 2004, the content in raw protein for the ***Fundulea 21*** hybrid***,*** was of 9,95 – 12,60 % and for the ***Tinca*** hybrid of 9,80 – 12,85 %, and for the ***Fundulea 32*** hybrid, of 9,90 - 12.75 %, a higher amount was recorded for fertilization with $N_{65}P_{50}$ and 20-30t/ha+$N_{65}P_{50}$ bovine manure.

In 2007, for the ***Fundulea 21*** hybrid, the content in raw protein increased from 10.24 % control, to 12.47 % after fertilizing with 30 t/ha+$N_{65}P_{50}$ bovine manure; raw cellulose decreased from 24.88 % control, to 20.70-20.57 % after fertilizing with 20-30 t/ha+$N_{65}P_{50;}$ the content in ashes had small modifications, and the highest content in fat was registered for the fertilization with $N_{65}P_{50}$ (2.15%).

For the ***Tinca*** hybrid there was a higher content in raw protein, compared to the ***Fundulea 21*** hybrid. Thus, compared to the control vale (10.18 %), after fertilizing with $N_{65}P_{50}$, the records showed 12.05 %, and after fertilizing with 20-30t/ha+$N_{65}P_{50}$ bovine manure there was a result of 12.36- 12.78 %; the content in cellulose decreased from 29.93 %,control value, to 20.75- 20.48 % after fertilizing with 20-30 t/ha+$N_{65}P_{50}$ bovine manure; the content in ash has also had small differences depending on the fertilization type (5.58 % control value to 6.97 % after adding P_{50}); the content in fat was of 1.42 % control value, and 2.30-2.42 % after adding 20-30 t/ha+$N_{65}P_{50}$ bovine manure.

The mass of 1000 beads (MMB) was influenced by the hybrids and fertilizing; for the ***Fundulea 21*** hybrid, MMB was of 18-29 g, for the ***Tinca*** hybrid, 20-33 g and for the

Fundulea 32 hybrid, of 23-38 g; the highest MMB values were recorded for the fertilizing with 20-30 t/ha+$N_{65}P_{50}$ bovine manure, for all hybrids.

In 2004, the hectoliter mass (MH) recorded values of 57-59 kg for ***Fundulea 21*** hybrid, 60-71 kg for the ***Tinca*** hybrid and 62-72 kg for the ***Fundulea 32*** hybrid, in 2007, the mass of 1000 beads (MH) was of 56–69 kg for ***Fundulea 21*** hybrid, 60–71 kg for the ***Tinca*** hybrid, and for the ***Fundulea 32*** hybrid of 61–72 kg, these values being higher for the fertilizing with 20-30 t/ha+$N_{65}P_{50}$ bovine manure.

For the silo sorghum, the content in protein and cellulose is more important for the forage.

In 2004, the content in raw protein for the ***Fundulea 21*** hybrid**,** was of 10.05 % (control) and higher for fertilizing with $N_{65}P_{50}$ (11.75-11.95 %); for ***Tinca*** hybrid was 10.35 % (control) and 11.45–11.95 % for fertilizing with bovine manure and mineral fertilizers, for ***Fundulea 32*** hybrid was 10.50 % (control) and 11.90–1195 % for combined fertilization; in 2007 ***Fundulea 21*** hybrid recorded content in raw protein of 11.25 % (control) and 13.37 % for fertilizing with 20-30 t/ha+$N_{65}P_{50}$ bovine manure, and cellulose records values of 24.75 % (control) and it decreases to 21.0 % after being fertilized with 20-30 t/ha+$N_{65}P_{50}$ bovine manure.

The influence of fertilization over the nutritional value of the forage obtained was calculated for the sorghum for silo.

For the ***Fundulea 21*** hybrid, the nutritional value of the forage, expressed in UNL/kg DM was of 0.88 kg/DM at control and of 0.99 kg/DM after fertilizing with 30 t/ha+$N_{65}P_{50}$ bovine manure, and the nutritional value expressed in UNC/ kg DM was recorded between 0.85kg/DM (control) and 0.98 kg/DM at the same dosage of fertilization.

For the ***Tinca*** hybrid, the nutritional value of the forage expressed in UNL/kg DM was of 0.91-0.98 kg/DM, higher after fertilizing with $N_{65}P_{50}$ and 20-30 t/ha+$N_{65}P_{50}$ bovine manure, and the nutritional value expressed in UNC/kg DM is between 0.88-0.97 kg/SU higher at the same fertilization.

For the ***Fundulea 32*** hybrid, the UNL/kg DM values are close, lower value at control (0.90) and higher after fertilization with $N_{65}P_{50}$ and 20-30 t/ha+$N_{65}P_{50}$ bovine manure (0.97-0.99 kg/DM); the nutritional values of the forage expressed in UNC/kg DM are of 0.87 kg/ DM (control) and 0.96-0.98 kg/DM after fertilizing with 20-30 t/ha+$N_{65}P_{50}$ bovine manure.

Several economical indicators were calculated at the end of the paper for sorghum for grains and for silo: total expenses, production cost, net income and profitableness rate.

For sorghum for grains, for the ***Fundulea 21*** hybrid, the production expenses are between 702-1522 lei/ha, net income of 1048 lei/ha (control) and higher after fertilizing with

20 t/ha bovine manure (1618 lei/ha); and after fertilization with 20 t/ha+$N_{65}P_{50}$ bovine manure (1528 lei/ha); the highest profitableness rate was recorded for fertilization with 30 t/ha (228 %).

The ***Tinca*** hybrid recorded production expenses of 702 lei/ha (control) and 1482-1522 lei/ha after fertilizing with 20-30 t/ha+$N_{65}P_{50}$ bovine manure; the highest net income recorded was for fertilizing with 20-30 t/ha bovine manure (1868-2178 lei/ha), and the highest profitableness rate was recorded for fertilizing with 30t/ha bovine manure (265 %).

For the ***Fundulea 32*** hybrid, production expenses were of 702 lei/ha (control) and higher for fertilizing with 20-30 t/ha+ $N_{65}P_{50}$ bovine manure (1482-1522 lei/ha); the highest net income was recorded for fertilizing with 30 t/ha bovine manure (2328 lei/ha), and the highest profitableness rate was recorded for fertilizing with 30t/ha bovine manure (283%).

For sorghum for silos, for the ***Fundulea 21*** hybrid, production expenses were of 705 lei/ha (control) and 1485-1525 lei/ha for fertilizing with 20-30 t/ha bovine manure; the highest net income was recorded for fertilizing with 30t/ha bovine manure (2235 lei/ha), and the highest profitableness rate was recorded for fertilizing with 20t/ha bovine manure (278 %).

For the ***Tinca*** hybrid, the production expenses were of 705 lei/ ha (control) and 1485-1525 lei/ha for fertilizing with 20-30 t/ha+$N_{65}P_{50}$ bovine manure, the highest net income was recorded for fertilizing with 30 t/ha bovine manure (2175 lei/ha), the highest profitableness rate recorded was for fertilizing with 30t/ha bovine manure (265 %).

As a result of fertilizing, the ***Fundulea 32*** hybrid recorded production expenses of 705 lei/ha (control) and 1485-1525 lei/ha after fertilizing with 20-30 t/ha+$N_{65}P_{50}$ bovine manure; the highest net income recorded was for fertilizing with 30t/ha bovine manure (2265 lei/ha), and the highest profitableness rate (282 %) was recorded for the same level of fertilization.

The paper is completed with conclusions, recommendations and a bibliographic list with Romanian authors and from abroad.