ABSTRACT

Linseed is an oleaginous crop which in 2004 has been cultivated in the world on a surface of around 2.6 million hectares, for its drying oil, which has an iodine value between 168-192.

With the exception of the traditional uses, linseed is being used more and more in pastry and bakery, because of its nice taste and the rich composition in Omega 3 acids (alpha linolenic acid) with many health benefits. Also, linseed consumption it is being studied for more than 10 years, because has been scientifically proved that has lots of benefits on human health, especially in lipids metabolism and in reducing the cardiac risks. Starting with 1992 linseed has become a source of edible oil, because in that year, in Australia, have been created the first two genetically modified varieties of linseed (Wallaga and Eyre) which have less than 5% linolenic acid in the oil content.

The doctoral thesis has a total number of eight chapters, with 306 pages, 163 tables and 79 figures. The thesis has two distinct parts:

The first part – which represents a *synthesis of the bibliographical data* regarding the subject of the paper, the natural frame description, the climatic conditions during the research, the material and methods of research and also, here we have put the bibliography. This part has a total of 93 pages with 42 tables and 23 figures.

The second part – in which we are presenting the *results of the research*. This part is including four chapters, with 191 pages, 121 tables and 56 figures.

The trials took place in Ezăreni Farm (The Didactical and Experimental Farm of the Iaşi University of Agricultural Sciences and Veterinary Medicine). The Ezăreni Farm it is located in the South-West part of the Moldavian Plane.

The trials took place for three years (2002-2004) the climatic conditions of these being very different: 2002 and 2004 have been good years regarding the rainfall, while 2003 has been a dry year.

For establishing the optimum seeding parameters for the linseed crop, in Ezăreni Farm has been done a three factor trial of the 3A x 5B x 3C type:

Factor A – *Time of seeding* - with three graduations:

a_1 – First time of seeding (2°C)

a_2 – Second time of seeding (5°C)

a_3 – Third time of seeding (8°C)

Factor B – *Variety* - with five graduations:

b_1 – Lirina

b_2 – Olin

b_3 – Florinda

b_4 – Raluca

b_5 - Fluin

Factor C – *Density of seeding* – with three graduations:

c_1 – 600 grains/m^2

c_2 – 800 grains/m^2

c_3 – 1000 grains/m^2

In the same time we have done a second trial to establish the optimum level of fertilization for the linseed crop, in Ezăreni Farm. This was a two factors trial of the 7A x 5B type:

Factor A – *Level of fertilization* – with seven graduations:

a_1 – N_0P_0 (control)

a_2 – $N_{64}P_{48}$

a_3 – $N_{64}P_{64}$

a_4 – $N_{64}P_{80}$

a_5 – $N_{96}P_{48}$

a_6 – $N_{96}P_{64}$

a_7 – $N_{96}P_{80}$

Factor B – *Variety* – with five graduations:

b_1 – Lirina

b_2 – Olin

b_3 – Linótt

b_4 – Raluca

b_5 - Alexin

To be possible to make the statistical interpretation of the results both trial have been planed in three repetitions, the surface of each plot being 22 m^2 (11 x 2 m).

We also have done chemical analyses (oil and protein content of the seeds, fatty acids composition, iodine value and peroxidic index), medical analyses (blood lipids), economically and energetically calculations.

The duration of the biological cycle of linseed has oscillated between 108-112 days when the seeding has been done at 2°C and between 92-93 days when the seeding has been done late (8°C).

On a three years average, the plant height of linseed has been increase very significantly by the fertilizers applied. The tallest variety from all seven that we have tried is Lirina (50.97 cm) and Florinda is the shortest (41.80 cm). Also the highest values of the plant height have been obtained in early seeding (2°C) (44.19 cm) and at 1000 grains/m^2 density (48.72 cm).

The seed yield of oil flax has oscillated according to all the studied factors (variety, doses of fertilization, time of seeding, density of seeding and the climatic conditions of each year). The variations have been statistically assured.

From all seven varieties tried in Ezăreni Farm, Olin, Fluin and Alexin have been the most productive.

The chemical fertilization of the linseed has produced a very significant increase of the yields in all three years of experimentation and also, on a three year average (2002-2004). On a three years average, the yield increase due to the chemical fertilization has varied between 33.59% (399.3 kg/ha) in $N_{64}P_{64}$ variant and 50.66% (602.2 kg/ha) in $N_{96}P_{48}$ variant.

The interaction variety x doses of fertilization is pointing out three variants: Alexin x $N_{96}P_{48}$, Olin x $N_{96}P_{64}$ and Olin x $N_{96}P_{48}$. All three variants have recorded yields higher than 1900 kg/ha.

On a three year average, between the normal seeding of linseed (5°C) and the early seeding (2°C) the yield differences were insignificant. The delaying of seeding until the temperature of the soil is reaching 8°C has produced an yield decrease of 11.9% (356 kg/ha) comparing with the seeding at 5°C.

The yields at the densities 600 and 800 grains/m^2 (2002-2004 average) have been practically equal. With 1000 grains/m^2 the yield decrease has been very significant comparing to the density of 800 grains/m^2.

The complex interaction time of seeding x variety x density is pointing out to variants: first time of seeding (2°C) x Olin x 600 grains/m^2 and first time of seeding (2°C) x Fluin x 600 grains/m^2. In both cases the yields were higher than 1800 kg/ha.

Chemical fertilization of linseed has produced very significant decreases of the oil content in seeds, comparing to the control variant. In average (2002-2004) the oil content has varied between 41.39% (N_0P_0) and 38.21% ($N_{96}P_{48}$). The highest oil content (41.17%) has been

recorded in Lirina variety and the lowest (38.10%) in Linòtt (in the experience with the chemical fertilization).

On the interaction variety x doses of fertilization, the highest oil content (43.57% and 41.45%) has been recorded in the control variants of Lirina an Olin, respectively and the lowest values (37.27% and 37.43%) on the interaction of Linòtt variety with $N_{96}P_{48}$ and $N_{96}P_{64}$, respectively.

Early seeding of linseed (2°C) has given the highest oil content (40.44%), while the delaying of seeding at 8°C has produced a very significant decrease in oil content (37.94%).

The seed oil content has increased from the density of 600 grains/m^2 (39.28%) to the density of 1000 grains/m^2 (39.83%). The differences have been statistically assured.

In the trial with seeding parameters, the highest oil content has been recorded in Lirina variety (40.60%) and the lowest (38.80%) in Florinda variety.

Protein content of the seeds has increased very significant in all the variants chemically fertilized. From all seven varieties, the highest protein content, in the experience with chemical fertilization (21.47%) and also in the trial with the seeding parameters (21.29%) has been recorded in Raluca variety. The lowest protein content has been recorded in Florinda and Olin varieties (20.24% and 20.47%, respectively).

The protein content has increased from the first time of seeding (2°C) (19.76%) to the third time of seeding (8°C) (21.66%) and has decreased from the density of 600 grains/m^2 (20.91%) to the density of 1000 grains/m^2 (20.36%).

From all seven varieties, the highest iodine values (184 and 182) have been recorded in Linòtt variety and Raluca, respectively, and the lowest iodine value (178) in Olin variety.

The absolute limits between which the fatty acids content has oscillated are: 5.7-6.6% palmitic acid, 3.2-6.3% stearic acid, 17.0-23.2% linoleic acid, 14.0-16.3% linoleic acid and 50.5-59.1% linolenic acid.

The researches regarding the diversification of the fields of utilization refer to two aspects: the way in which the storage of the seeds is affecting the alteration degree of the fats and the way in which the consumption of linseed seeds is influencing the evolution of the hyperlipidemic patients (with high level of fats in the blood).

The alteration of the fats has been determined by the peroxidic index. During of one year of storage the fats from the seed content are oxidation, with an intensity which is being influenced by the form of storage (whole seeds or ground seeds) and also by the temperature of storage.

When the storage of the seeds has been done as whole seeds, during one year of storage it can be seed a slight increase of the peroxidic index value (from 0.014 to 0.020) but without affecting the freshness degree of the fats, no matter what was the storage temperature.

When the linseed was stored as ground seeds the speed of oxidation was much higher, being directly proportional with the storage temperature. The fats from the ground seeds has become unsuitable for storage after one month-when the storage has been done at the room temperature, after three months-when the storage has been done at 10°C and after four months-when the storage has been done at 5°C.

The medicinal study has been done with the help of a qualified team from the Iasi University of Medicine and Pharmacy and from the Roman City Hospital. For this study we have used a sample of 40 patients with total cholesterol more than 240 mg/dl and the total cholesterol/LDL cholesterol ratio more than 4.5. The duration of the study was two months.

The group of 20 patients that fallow a hypolipidemic diet associated with a daily consumption of 20 g of ground seeds of linseed have recorded a very significant reduction of the total cholesterol (17.2%), LDL cholesterol (3.9%), triglycerides (36.3%) and of the total cholesterol/LDL cholesterol ratio (33.5%).

In the economical analysis we have calculated for each variant of the trials the total expenses, total income, gross profit and the profit rate.

The linseed fertilization with chemical fertilizers has produced a decrease of the profit rate, because of the expenses involved in this technological input (between 36.8 and 48.1% from the total expenses).

From all the variants of fertilization that we have tested the highest profit rates (123.1 and 119.0%) have been obtained with $N_{96}P_{48}$ and $N_{64}P_{48}$, respectively.

From the energetically indexes we have analyze energetically balance and energetically efficiency.

The chemical fertilization of linseed has produced an important reduction of the energetically efficiency, because of the big energetically input included in the chemical fertilizers.

Total energy produced on one hectare of linseed has varied between 33655 MJ per hectare (Raluca x N_0P_0) and 45684 MJ per hectare (Lirina x $N_{64}P_{80}$).

From all the results of our research we recommend:

- In the ecological condition of the Ezăreni Farm the best linseed varieties, from all seven that we have tested, are: Alexin, Fluin and Olin;

- The seeding of linseed could start at 2°C (temperature of the soil) and must me finished at 5°C, the differences between these two times of seeding being insignificant;
- If in the utilization of the linseed yield we are first interested of the oil content, the best choice is Lirina variety which has recorded 1-2 oil percents more than the other varieties;
- The density of seeding must be between 600 and 800 grains/m^2, the increasing above theses limits being economically and agronomical unjustified;
- For establishing the fertilization doses of linseed in the ecological conditions of the Ezăreni Farm it is very important to consult the weather forecast for the next year. If they predict a dry year we recommend the fertilization with $N_{64}P_{80}$ and in the situation of o good year (regarding the rainfall) we recommend $N_{96}P_{48}$;
- In the situation in which the linseed seeds are going to be used in pastry or in bakery, the storage of the yield must be done as whole seeds, and the milling to be done with maximum one month before utilization;
- Daily consumption of 20g of ground seeds, associated with a healthy lifestyle, may contribute (by the reduction of the values of the lipid profile parameters) to the reduction of the cardiovascular risk.