

## ABSTRACT

The PhD thesis THE INFLUENCE OF CROP ROTATION ON IRRIGATED MAIZE UNDER CONDITIONS OF THE DOBROGEA PLATEAU developed during the period 2004-2007, when field studies, laboratory and office work took place in order to explain the results and elaborate the thesis. The organization on scientific basis of agriculture brought again in present times the problem of crop rotation. The most eloquent proof of this fact is the numerous studies and experiments made in the countries with advanced agriculture.

As expected, there isn't an unity in opinions regarding the adoption of specific types of crop rotations, but the utility of crop rotation in the struggle to obtain a continuous increase of agricultural production, quantitatively as well as qualitative, is entirely recognized.

The influence of crop rotation on production and soil fertility is being studied in some countries for more than 150 years.

The researches show that crop rotation can not be replaced, acquiring new aspects under modern agriculture (*Cox R. D.*, 1964).

The influence of crop rotation on organic substance and the material basis of soil fertility are achieved especially through vegetable remains in soil from crops by their quality and quantity (*Klap E.*, 1965; *Vez A.*, 1966; *Konnecke C.*, 1967; *Voroviev S.A.*, 1970; *Riviere J.*, 1970; *Morachon C.*, 1972).

The advance crop influences the following one also by the soil state after harvesting, taking into account the water and nutritive elements supply and micro-organism activity level. (*Ivanov C.* 1968; *Semetov I.*, 1968; *Mosolov V.P.*, 1970; *Riviere J.* 1970; *Smika D.E.*, 1973).

The chemical fertilizers rationally applied lead to the increase of soil fertility, highly increase the yields and improve the biologic value of agro-food products (*Gupalo P.*, 1968; *Didicenko A.P.*, 1971).

The researches regarding the influence of advance crop in order to limit the pathogen attack are based on the fact that each culture has a direct influence on soil micro-flora; the presence of the same yield on the same field leads to its disequilibrium.

Among maize diseases, *Fusarium* generates quantitative and qualitative damages. The accumulation of *Fusarium* fungus on grains and corn-cobs leads to the increase of mico-toxins

very dangerous to people and animal health (*Wilson D. M.*, 1980; *Nelson P. E.*, 1993; *Marasas W. F. O.*, 1997).

Crop rotation also represents a method for weeds reduction. An alternation between many crops with different requirements towards yield technologies, combined with the use of chemicals at crops which allow without risks the use of herbicides, represent the key of an efficient weed control (*Laver J.*, 1993; *Sax L.*, 2003).

By introducing crop rotation where stalky cereals alternate with maize, sun flower, soybean, sugar beet for 5 years, the weed encroachment decreases. Crop sequence in crop rotation influences differently the degree of weed encroachment (*Post B. J.*, 1996).

Many researches performed in our country show that the presence of organic material in soil, the hydro-stable aggregates percentage as well as water stability depend and are influenced not only by plants but also by their rotation on field, nature and the quantity of fertilizers (*Margareta Handra*, 1964; *Braun H.*, 1965; *Șerbănescu N.*, 1968; *Onisie T.*, 1972; *Ana Arfire*, 1974; *Stratula V.*, 1978; *Pintilie C.*, 1979; *Dincă D.*, 1982; *Mihăilă V.*, 1994 *Raus L.*, 2005) .

Applying fertilizers considering soil analysis, without taking into consideration the crops and their rotation is not a method of increasing soil fertility. For maximum production, any crop needs different quantities of fertilities dictated by the advance crop (*Bădescu Luiza*, 1970; *Budoii Gh.*, 1972).

The phyto-sanitary role of crop rotation was highlighted by many researches. In our country, systematic researches regarding crop rotation and diseases and pests attack interaction have been performed in many researches centers, these results confirming the ones obtained in other countries (*Rădulescu E.*, 1969; *Hulea Ana*, 1968; *Țârcomnicu Marina*, 1965, 1973; *Sarca Tr.*, 1974; *Căbulea I.*, 1976, 1977; *Cosmin O.*, 1987; *Craiciu D.*, 1980, 1983, 1989; *Emilia Procopovici* 1993; *Nogy Elena*, 1997; *Pălăgeșiu I.*, *Andru Monica*, 2002).

Rotating crops from one year to another, with different agro-biological requirements and specific parasites, creates disequilibrium in the biological evolution of pathogens and reduces their attack potential.

Many studies regarding weeds biology and their control were performed in our country. Systematic researches on crop rotation influence on the degree of weed encroachment were done in all research centers. The effect of crop structure on weed encroachment as well as the long

term effect of crop rotation were studied (*Sin Gh.*, 1975; Onisie T., 1993; *Ciorlăuș A.*, 1996; *Budoï Gh.*, 1998; Pintilie C., 1982; Ionescu N.E., 2000; Ciontu C., 2003; Nagy C., 2004).

Using crop rotations with plants which have different characteristics and yield technologies, the weeds increase can be limited, fact synthesized in many studies and researches.

The durable development, considered as the only viable alternative for mankind, implies a progressive transnational and global process, which deploys at economical, social, political and philosophical level.

Maintaining or introducing new technological systems shall be done in accordance with the principles of durable progress, in order to ensure the possibility of durable development.

**The main objectives** formulated in view of obtaining the paper, have been:

- The establishment of the most efficient types of crop rotations that shall ensure the improvement of soil fertility;
- The influence of the advance crop on the protection and intensification of the biological activity of soil;
- Emphasizing the influence of crop rotation and azote fertilization on the development of pathogens and weeds in view of eliminating the pesticides from maize technology or limiting their usage;
- The establishment of best azote doses depending on advance crop;
- The influence of crop rotation and azote fertilization on phosphorus constant base, on emergence density, on productivity elements in view of increasing production and reducing diseases and weeds infestation;
- The economical efficiency of different crop rotations and azote doses in view of choosing the most profitable technological elements.

The experiment was performed at Agricultural Research-Development Centre Valu lui Traian during the period 2004-2007, on chalky chernozem. At 0-25 cm depth, humus content is 3,5% and pH value is 7,8. The experiment was poli-factorial, located using the alternative blocks methods, with the following factors: factor A – crop rotation with 4 rotations: a<sub>1</sub> – monoculture, a<sub>2</sub> – 2 years crop rotation wheat – maize, a<sub>3</sub> – 3 years crop rotation wheat – maize – soybean, a<sub>4</sub> – 4 years crop rotation wheat – sugar beet - maize – sun-flower; factor B – different azote dozes on

constant phosphorus base with 5 rotations. At maize these rotations have been:  $b_1 - N_0$ ;  $b_2 - N_{60}$ ;  $b_3 - N_{120}$ ;  $b_4 - N_{180}$ ;  $b_5 - N_{120} + 10$  t organic fertilizer.

The experiment placed at S.C.D.A. Valu lui Traian includes 3 big fields in rotations: one field contains the four crop rotations maintained since 1983, two fields where lucerne alternates with the four rotations every 4 years.

**Rapsodia hybrid has been used.**

The following observations and determinations have been made: the degree of weed encroachment was established by field observations using the metric frame, the diseases attack was established through field observations and laboratory, noticing the attack frequency and intensity, the productivity elements and production have been determined in laboratory. The determinations regarding the chemical characteristics of the soil (pH, azote content, phosphorus and potassium, humus) have been performed in the laboratory from Pedology and Agro-chemistry Office using the method from Research for Pedology and Agro-chemistry Institute București.

*Statistical explanation* of all the results has been done analyzing the variation and correlation.

The results have been centralized in tables and charts.

The researches performed during the period 2004-2007 at Agricultural Research-Development Centre Valu lui Traian, Constanța, regarding the influence of crop rotation on maize production under irrigating conditions, revealed the following aspects:

**Soil reaction** was not influenced by the advance crop or by azote doze, remaining low alkaline, with values between 7,7 and 8,0.

**Humus content** has raised as azote doze increased from 2,59% to 3,10%. Applying 10t/ha organic fertilizers yearly together with chemical fertilizers lead to the increase in humus content, inclusively in monoculture, reaching 3,10% and 3,41 – 3,74% at the other crop rotations.

The highest **azote content** in soil is met at 3 years crop rotation and increases together with the rise of azote dozes.

By applying yearly 90kg/ha **phosphorus**, no matter the crop, the soil remains well supplied with this element. The organic fertilizer leads to the increase of phosphorus content in the soil. The lack of azote in monoculture determined the increase of phosphorus in soil, the disequilibrium disturbing plants development.

As soils are rich in **potassium**, it is not applied to crops. After maize harvesting, the differences between variants are very low. In crop rotation with improving field a big quantity of phosphorus have been determined: 84 ppm and potassium: 344 ppm, a high percentage of humus: 3,79% and a low alkaline pH: 7,9%.

**The number of weeds** at maize crop (at square meter) varies depending on crop rotation and fertilization.

*At crop rotation with improving field*, the highest number of weeds is met in monoculture; the annual monocotyledonous weeds are the most often met in all crop rotations, being followed by annual dicotyledonous and perennial dicotyledonous; perennial monocotyledonous weeds appear only in 2 years crop rotation at N<sub>250</sub> doze; the most frequent annual monocotyledonous: *Echinochloa crus galli* and *Setaria viridis*; there are 5 annual dicotyledonous weeds in monoculture, and 3 in other rotations: *Chenopodium album*, *Amaranthus sp* and rarely *Sonchus oleraceus*; N<sub>180</sub> fertilization lead to an increase of weeds in monoculture and 3 year crop rotation; N<sub>250</sub> fertilization and N<sub>180</sub>+10t organic fertilizer influenced the increase of weeds/sm in 2 and 4 crop rotations.

*In crop rotation without improving field*, the number of weeds decreased in all rotations; annual monocotyledonous weeds are the most frequent, being followed by perennial monocotyledonous (excepting 4 year crop rotation); the annual monocotyledonous is represented by *Echinochloa crus galli*; perennial monocotyledonous weeds are represented *Sorghum halepense*; annual dicotyledonous and perennial dicotyledonous weeds are rarely met; annual dicotyledonous weeds are represented by *Amaranthus retroflexus*, *Papaver dubium* and *Galinsoga parviflora* are sporadic; perennial dicotyledonous weeds are represented by *Convolvulus arvensus* and rarely by *Cirsium arvensis*; high azote dozes didn't lead to the increase of number of weeds/sm, excepting the monoculture where the maximum was at N<sub>250</sub> variant;

Cultivating the maize in long term crop rotation has lead to the decrease of number of weeds and of present species.

**Rapsodia hybrid has a good genetic resistance to diseases;**

The powdery mildew at corn-cobs, produced by *Fusarium graminearum* Schw. was the most frequent, producing quantitative and qualitative damages;

In **crop rotation with improving field** the frequency of corn-cobs attacked Fusarium was high but the attack degree was low due to the low number of pathogens;

In **crop rotation without improving field** the frequency of corn-cobs attacked Fusarium was low but the attack degree was high, the number of pathogens being higher;

The climatic conditions, the type of crop rotation, the advance crop and azote dozes on constant phosphorus base ( $P_{90}$ ) influenced the **productivity elements**:

- **Average number of corn-cobs per plant** was between 0,8 - 1,4.
- **Average weight of corn-cobs per plant** was over 220g in crop rotation with improving field, in all crop rotations and at every azote dozes, reaching the maximum (250g) in 3 year crop rotation, on  $N_{180} + 10t$  organic fertilizer.
- **1000 grains mass** had maximum vales (280-320g) in crop rotation with improving field in all rotations and every azote dozes. In crop rotation without improving field, values MMB were between 262g and 320g
- **Efficiency** was between 80,2% and 83,5% at crop rotation with improving field and between 77,5% and 82,2% at crop rotation without improving field
- **Production:**
  - From the all 4 experimental years, in 3 of them have been produced the biggest productions in 3 years crop rotation (2005, 2006 and 2007) and in one year (2004) in 4 years crop rotation, in crop rotation without improving field. In crop rotation with improving field, the 3 year crop rotation has been superior.
  - The influence of azote fertilizers on production is significant. Maximum production was at  $N_{250}$  doze: 9970kg/ha (2004), 9630kg/ha (2005) and at  $180+10t$  organic fertilizer: 9370kg/ha (2006) and 9850kg/ha (2007), in the experiments placed on crop rotation without improving field. In the experiments placed after improving field the same thing has happened. Maximum production was at the variant fertilized with  $N_{250}$ : 12150kg/ha (2004), 11800kg/ha (2005) and at  $N_{180}+10t$  organic fertilizer doze, 12110kg/ha (2006) and 12480kg/ha (2007).
  - The interaction rotation x azote doze shows that at the crop rotation without improving field production increases together with the increase of azote doze to 250 (in 2004, 2005 and 2007) and to  $N_{180}+10t$  organic fertilizer in 2006, from

monoculture to 4 year crop rotation in 2004 and to 3 year crop rotation in 2005, 2006 and 2007.

- Although maximum productions were at N<sub>250</sub> and N<sub>180</sub>+10t organic fertilizer doze, N<sub>180</sub> doze remains the economical doze where production justifies the expenses.
- From the **economic** point of view, if a crop rotation without improving field is used, 3 and 4 years crop rotations are the most efficient, even though fertilization with azote was not used, the profit increasing together with the increase of azote doze due to the fact that production is also increased. The use of improving field leads to profit in all types of crop rotations and in monoculture, at all levels of azote fertilization.

The results highly confirm the writing from literature, but are specific to the experimental conditions and contribute with innovative elements for a better understanding of phenomena.