THE EFFECT OF MALEIC POLYELECTROLYTE „PONILIT GT1" ON SOIL STRUCTURE AT SOYBEAN CROP

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The main objective of this study consists in testing the effect produced by maleic polyelectrolyte Ponilit GT1 on water stable aggregate. The solutions of Ponilit GT1 was applied to surface of a cambic chernozem with a clay loamy texture, from Didactical Station of USAMV Iași, Ezãreni Farm, 6,6 – 6,9 pH units, 33 – 34 % clay content, at three different doses: 0.3%, 0.1% and control. Changes in structural parameters such: water stable aggregate, mean weight diameter, wet aggregate stability were determined. Cambic chernozem soil structure development was evaluated by comparing the values of structural parameters treated with maleic polyelectrolyte with those untreated. The results of our study indicated that synthetic polymer had a significant effect on structural development and on structural parameters. The results obtained at 0.3% and 0.1% doses indicate increasing of water stable aggregate with values between 19 – 29% on horizon 0 – 2 cm comparative with the control, and increasing in mean weight diameter with 9.5% at 0.1% doses and 15% at 0.3% doses. The application of synthetic polymer Ponilit GT1, creates favorable conditions for seeds germination. From the point of view of climatic conditions, the area where the experience is located is characterized by annual average values between 529 – 550 mm precipitation and mean multiannual temperatures between 9.2 – 9.4 ^{o} C.

***Key words**: soil structure, hydric stability, soil tillage*

The presence or absence of water stable aggregate on soil surface, tends to an immediate effect on crust formation and on increasing hydric erosion of soils [11]. Soils shows at the surface an amounted percent of water stable aggregate, have a good resistance to hydric and aeolian erosion, comparative with the soil where the percent of unstable aggregate is sizable [7]. Synthetic polymers added to different soils to improve soils physical, chemical and biological properties, have been studied by many researchers [6.8.4.5.], and the use of these polymers is known in the last 60 years by several works already accessible [1.2]. Synthetic polymers added to soil as soil conditioners improve soil physical properties, are important for plant growth and increases soils resistance against disruptive forces and erosion [9]. The laboratory researches and experimental practice extraordinary rich, could not maintain this enthusiasm to the level of the beginning because this produces were to expensive, the effect on soils it wasn't know, neither for plant growth and neither on human by alimentation. After 1980 years, the interest of these soil conditioners, called hydrogels, increased again because of low prices and for their remarkable quality: were ecological, untoxic and some of them biodegradable. The uses of small quantities of synthetic polymers per hectare contributed to a suggestive decreasing of costs, the interest of plant grower for these kind of produces could be enhanced [13].

MATERIAL AND METHOD

The experience is monofactorial, A X B type, is set up in split plots design in three repetitions. The plot covered surface was 18 m ^{2}. The experimental variants were:

Factor A: tillage systems:

- a_1 – ploughed at 30 cm + Lemmkeen cultivator;
- a_2 – ploughed with paraplow + vertical rotary harrow;
- a_3 - ploughed with paraplow + horizontal rotary harrow;
- a_4 - ploughed with chisel;
- a_5 – tillage only with disk harrow;

Factor B: macromolecular compounds:

- b1 - control
- b2 - soil treated with 0.1% polymer a.i./ha
- b3 - soil treated with 0.3% polymer a.i./ha.

These experiments carried out, during 2006-2008, studied maleic polyelectrolyte Ponilit GT1, with an content of 27.7% (7,2 kg/ha) active ingredients in first year and 17% (11,7 kg/ha) active ingredients in second year. To ensure that the treatment will be effective, before the application of synthetic polymer, the soil is watered approximate 2 cm thickness. The amount of solution that would be treated was 2000 l/water/ ha, applied by hand. The control variant was watered too. To dignify the effect of the synthetic polymer on soil structure and indirectly on physical and chemical properties of soil, were collected samples from 0 – 2 cm depth.

The determinations performed and the methods used are: the distribution and stability of structural macroaggregates according the Tiulin Eriksson procedure (wet sieving methods), dry sieving method was attained by using a sieve set with 10, 5, 3, 2, 1, 0,5 and 0,25 mm diameter.

RESULTS AND DISCUSSIONS

Physical and chemical properties and structural parameters of cambic chernozem from Ezãreni Farm cultivated with soybean were studied and given in *table 1*. The experiment was set up on a cambic chernozem with a clay loamy texture, has a high clay content 43,8%, a mean humus content (3.4 – 3.6%), is well supplied with mobile potassium and moderately with phosphorus and nitrogen, with values of hydric stability between 53.55 – 58.30 %, with mean weight diameter between 3.27 – 3.79 mm.

The results of the researches carried out in the field demonstrated that the soil treated with maleic polyelectrolyte Ponilit GT1 improve soils structure. Analytical data shown in *table 2* concerning the improvement of soil structure by treatment with maleic polyelectrolyte Ponilit GT1, registered significant increases of hydrostabile macroaggregates content, the effect being both for conservation and for restoration of soil peculiarities.

Table 1

Physical and chemical properties and structural parameters of cambic chernozem studied

Physical and chemical properties	
Texture	clay loamy
pH	6,7
Humus (%)	3,4-3,6
Coarse sand (2-0,2 mm)	3,0
Fine sand (0,2-0,002 mm)	22,9
Silt (0,02-0,002 mm)	30,3
Clay (<0.002 mm)	43,8
Bulk density (g/cm^3)	1,06-1,14
Hydric stability (%)	53,55-58,30
Total porosity (%v/v)	59,1

The control variant registered the smallest hydric stability values which are represented by values between 53.55% at disk harrow and 58.30% for ploughed at 30 cm. From the point of view of concentration in both years, the biggest mean values of hydrostability were registered at the doses of 0.3% polymer a.i/ha, with the minimum limits registered by disk harrow (69.20), paraplow (70.35 – 70.70%) and chisel (71.25%) and maximal to variant ploughed at 30 cm (74.65%). The values of **hydric stability** registered at 0.1% doses polymer a.i./ha are higher with 18.3 – 20.3% toward the control variant and lower with 9.6 – 10.4% from 0.3% doses.

From the analysis of influence of tillage system on hydric stability have been found remarks between conventional and unconventional tillage, in both years, ploughed at 30 cm registered, regard paraplow, chisel and disk harrow, higher limits with 3.4 – 5.0 % at control variant, 3.2 – 5.3% to 0.1% concentration and 3.9 – 6.1% to 0.3% concentration.

According the appreciation classes [10] of structural hydrostability of soil, it was observed an oscillation of the values registered from an fragmentary soil at control variant, to an structured soil, at 0,3% polymers a.i/ha

The statistical analysis of mean values of hydric stability, have shown that the indicator registered higher values between 19% and 29% to 0.1% and 0.3% concentration regard the control variant (55.2%), the difference is treated to be significant. It may be observe that the variants where the prepare of seed germination has been done with rotarry harrow, the values of hydric stability of structural aggregates are lower, aspect that can be demonstrated statistically. The results registered, confirm the beneficial effect of Ponilit GT1 on increasing hydric stability and improving soil structure quality.

At the soybean crop, the values of **mean weight diameter (MWD)**, increased with the increasing of synthetic polymer doses, having obtained maximal values in classical tillage system, where regard the control variant (4.64 mm) the limits of MWD reached 4.82 mm (0.1% polymer a.i./ha) and 4.97 mm (0.3% polymer a.i./ha), the minimum values have been registered at the chisel and paraplow variants, which represents 3.62 – 3.68 mm (0.1% polymer a.i./ha) and 3.70 – 3.81 (0.3% polymer a.i./ha), comparative with control variants (3.27 – 3.36).

Table 2

The influence of synthetic polymers on soil structure indicators of Ezăreni – Iași cambic chernozem, cultivated with soybean, mean values 2006 – 2008

Tillage system	Doses (% polymer a.i./ha)	Wet aggregate stability	Significance (%)	Mean weight diameter	Significance (%)
Ploughed at 30 cm	Control	58,30	100,0	4,64	100
	0,1%	69,05	118,40 xxx	4,82	103,9xxx
	0,3%	74,65	128,00 xxx	4,97	107,1xxx
Paraplow + Vertical rotarry harrow	Control	54,55	100,0	3,33	100
	0,1%	65,10	119,30 xxx	3,62	108,9xxx
	0,3%	70,70	129,60 xxx	3,70	111,1xxx
Paraplow + horizontal rotarry harrow	Control	54,90	100,0	3,27	100
	0,1%	64,95	118,30 xxx	3,64	111,4xxx
	0,3%	70,35	128,10 xxx	3,78	115,6xxx
Chisel+ horizontal rotarry harrow	Control	54,70	100,0	3,36	100
	0,1%	65,80	120,30 xxx	3,68	109,5xxx
	0,3%	71,25	130,30 xxx	3,81	113,4xxx
Disk harrow	Control	53,55	100,0	3,79	100
	0,1%	63,65	118,90 xxx	4,03	106,2xxx
	0,3%	69,20	129,20 xxx	4,18	110,1xxx

The disk rotary variant registered transitional values between ploughed at 30 cm and chisel and paraplow variants, obtaining increments once the rate of synthetic polymer applied increase.

From the point of view of concentration the smallest values were obtained at 0.1% polymer a.i. /ha, having provided regard control variants, by 4% at ploughed at 30 cm, 6.2% at disk harrow variant and 9 – 11% at chisel and paraplow variants.

Increasing the dose of maleic polyelectrolyte Ponilit GT1 at 0.3%, the values have registered increments regard control variant, approximately 7% at ploughed at 30 cm, 10% at rotarry harrow, 13% at chisel and 11 - 15% at paraplow.

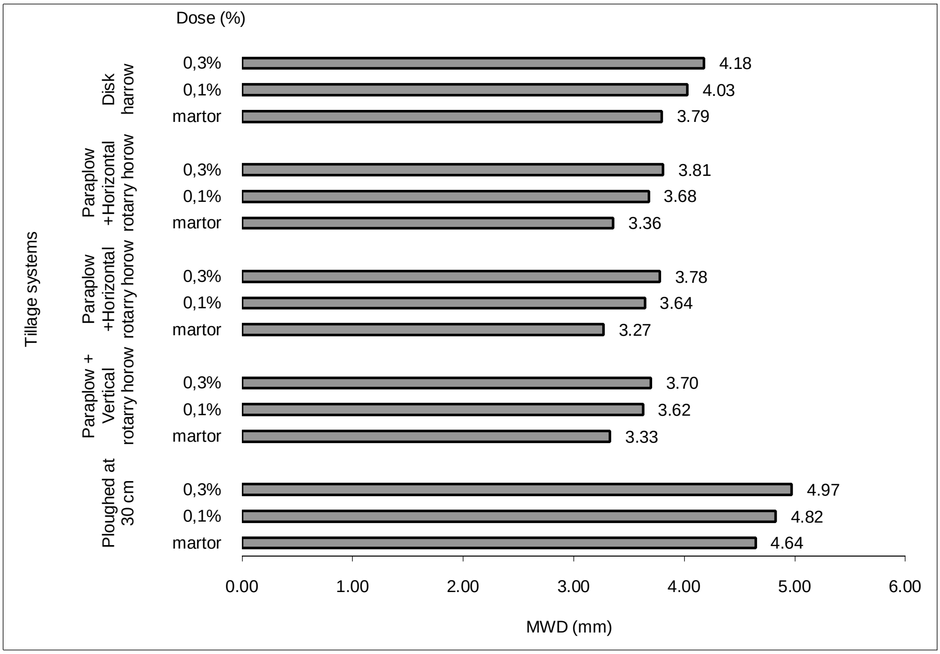

Figure 1 **Mean weight diameter to soybean crop, mean values 2006 – 2008**

The statistical analysis shows significant negative differences in variants treated with 0.1% and 0.3% doses polymer a.i./ha comparative with control variant.

CONCLUSIONS

The following conclusions are specified regarding the improvement of soil structure with maleic polyelectrolyte Ponilit GT1 applied to soybean crop, mean values of 2006 – 2008:

The results registered confirm the beneficial effect of Ponilit GT1 on increasing hydric stability and improving soil structure.

The mean values of 2006 – 2008 shows increasing of hydric stability from 53.55 – 58.3% in control variant till 63.65 – 69.05% at 0.1% concentration, respectively 69.2 – 74.65% at 0.3% concentration.

Mean weigh diameter shows the smallest values at 0.1% concentration, having obtained increasing regard control variant by 4% to ploughed at 30 cm, 6.2% to disk harrow variant and 9 – 11% to chisel and paraplow variant.

Increasing the doses of maleic polyelectrolyte to 0.3% the values registered increases regard control variant, about 7% to ploughed at 30 cm, 10% to rotarry harrow variant, 13% to chisel variant and 11 -15% to paraplow variant.

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