Growth analysis of sweet pepper for investigation effect of wood ash and poultry litter on plant

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Abstract: *The present study uses the method of soil crops to study the fertilization of the soil, changes in the content and forms of nutrients, the effectiveness of various forms of nutrients introduced by the resulting of soil improver - a mixture of waste – wood ash and poultry litter, by means of a vegetation experiment. Sweet pepper Capsicum annuum subsp. macrocarpum L. was selected for the experiment, variety of gate type - Gold medal 7. The results of the study prove the ability to use soil improvers, good resistance of the leaves to sudden intense changes in climatic conditions. The root systems of all mixtures are well developed and strong, stable with good agrochemical parameters compared to that of the zero sample.*

Keywords: *SOILS, SOIL IMPROVER, WOOD ASH, POULTRY LIITER*

1. Introduction

Globally, a sustained trend towards sustainable agriculture is being captured. The European Union is aiming for greener agriculture so that scarce resources are managed more effectively. This is based on the concept of growth in sustainable productivity and a longer resource base existence to feed a growing population. Innovative approaches also improve rural life.

The concept of sustainable development takes into account the specific characteristics of each region and helps to develop its potential. The development of regional and local food systems, which can play an important role in reducing greenhouse gas emissions in agriculture and the agri-food system, is supported, while saving energy, improving the health of the nation, and enhancing the overall sustainability of agriculture. One of the main points for implementing good sustainability systems and minimizing the negative environmental impact of agriculture is the reduction of the use of synthetic fertilizers by using animal and integrated systems to retain significant levels of carbon in the soil. The utilized agricultural area for 2019 in Bulgaria is 45.4% of the area of the country and differs by 0.1% from the previous year [1] On the other hand, the cost of fertilizers and plant protection products is 37.2 EUR /ha [2].

Manure from poultry farms (MPF) is a waste product that belongs to group II contaminators, as it is also a carrier of energy and optimal for autotrophic organisms the content and ratio of biogenic chemical elements. Although the organic substances contained therein are fully included in the biogeochemical cycles of the cycle of substances, there are certain features that make it difficult to solve the problem. Above all, the organic substances in manure are of high concentration. Their composition is not permanent and depends on many factors – the species, age and state of health of the animals, the quality of the feed and the composition of the ration, metabolism, season, etc. The amount of MPF received, without bedding, per 1000 laying hens is 10 091 kg of dry matter for 12 months. Daily feces in laying hens are determined about 10% of the mass of birds. A direct relationship between the feed consumed and the fresh MPF received has been established - approximately 1.15 kg of fresh manure is obtained per 1 kg of feed consumed [3]. It contains thirteen of the most important nutrients for plants – N, P, K, Ca, Mg, S, Mn, Cu, Zn, Cl, B, Fe, Mo, which makes it a valuable fertilization tool. [4] Fresh MPF from laying hens contains about 1.0-1.8% nitrogen, 0.8-1.2% phosphorus, 0.5-0.7% potassium. "Typical" dry matter and nutrient content in MPF - 25-46% dry matter, 13-17 kg/t nitrogen, 4-21 kg/t phosphorus, 3-15 kg/t potassium [2].

The number of birds as of December 31, 2019 in Bulgaria is 0.3% higher than December 31, 2018 and reaches 15.6 million. Number. Laying hens and adolescents increased by 2.2% to 7.107 million. number [5]. Of these, 4.785 million the number are stock carriers, 1.084 thousand 1.238 million. the number are adolescents. In the poultry farms with 10,000. and more laying hens and adolescents are reared 86.9 % of the birds or 6.2 million. Number. [5] The choice of an effective method and technique for treating poultry waste is particularly important for areas where larger poultry plants are concentrated, increasing the risk of environmental pollution and endangering human health. One of the biggest challenges in modernizing poultry production is the need to balance the feeding of arable soils and the reduction or elimination of harmful effects on the environment, while respecting animal welfare regulations. The results of the practices carried out and the studies and tests carried out in different poultry farms demonstrate the economic and environmental expediency of the application in practice of the different types of composting or thermal treatment, as well as the usefulness of different sorbents with a direct impact on the carbon dioxide content of the atmosphere. A disadvantage of these best practices is the duration of treatment for composting and high initial investments and operating costs in thermal treatment [6].

The present study aims to apply an integrated approach by using appropriate additives from biomass ash avian excrement, which on the one hand improves the balance of nutrients and, on the other hand, to change the characteristics of new products in order to achieve greater efficiency in production and application in a shorter time. After characterizing the properties of the new products obtained, test vegetation vascular trials to assess agrochemical effectiveness should be planned and carried out. The proposed new solution is constructed on the basis of waste from poultry farms with additional waste products from other production and raw materials. The aim is to make integrated utilization of several types of waste, drying of waste to the desired humidity, stabilization and decontamination of the waste in order to improve its properties and composition. As a result, it is expected that once the bioactive components are destroyed, the release of smelling gases will be discontinued. This will allow for its further processing without the need for special measures. Thus, it is assumed that the end result is achieved in the face of a product that can be used as a soil improver.

2. Study area, methods and materials

Used raw materials and waste

As the main raw material resource, bird waste from the Big Dutchman system, adopted by ET "Valentin Georgiev – VALDIS" in the cultivation of stock carriers, provides the opportunity to provide sufficient area for each bird and is of utmost importance for its health and general condition. The poultry farm is located outside urbanized areas and quiet areas. The activity of the company is carried out on the territory of Kyustendil Municipality in the village of Shishkovtsi, which is located about 9 km north of the town. Kyustendil. The poultry farm is remote from the residential area of the village and they are not reached by intensely smelling substances inherent in this type of activity.

The operator holds complex permit No 313-H0-A0/2008, updated by Decision No 313-H0-A1/2015. According to the Annual

Environment Report (EDS) 2017. [7] The operator has declared an annual capacity of 70 536 bred birds. Production halls are cleaned twice a week and the formed waste – poultry manure is handed over to the population for fertilization of agricultural land. If temporary storage is necessary, the bird manure shall be stored on a separate site. A total of 584 tonnes of bird manure was formed on the site in the past year. For the purpose of research, fresh poultry waste shall be used. As the first basic approach for the effectiveness of the application of the method is to reduce the content of the content so as to avoid pollution of water, soil and ambient air. Wood ash obtained in the processing of pulp wood in "Svilosa-AD" is also used. As a result of the organized incineration of wood waste [8] wood ash is generated in an amount of about 10 000 tonnes per year. Wood ash contains all mineral nutrients that are not volatile in the thermal combustion process. They are in the same proportions as elements as they were in the structure of the wood mass used for combustion, from which they are suitable for improving soil structure and reservistity [9,10].

Materials

***Development of soil improvers*.** To achieve the objectives of this study, two mixtures of with different content of poultry litter and wood ash were prepared:

Mixture 1.1 - Poultry excrement: Wood ash: Sulphur acid (9:1:1)

Mixture 5.1 - Poultry excrement: Wood ash (1:1)

After complete homogenization of the mixtures, they are granulated by an extruder. The developed soil enhancers are characterized by Optical emission spectrometry with inductively coupled plasma High Dispersion ICP-OES Prodigy. The selected waste and other raw materials have been found to have a structure and composition which identifies them as carriers of basic and micro-nutrients, without overweight heavy and toxic elements, allowing them to be classified as suitable components for obtaining soil improver [11];

Vegetation experiment (VE). To evaluate the effectiveness of the application of the created soil improvers, a vegetation experiment was conducted.

Pepper in our country is grown in all areas of the country. 63,982 tonnes in total per year in Bulgaria is extracted pepper with an average yield of 18 726 kg/ha [12]

Pepper is selected, which representative belongs to the species Capsicumannuum from the sem. Solanaceae subspecies of large-fruited pepper Capsicumannuumsubsp.macrocarpum, variety type capies - Gold medal 7. [13].

Seed sowing and plant care

The seeds are flat, rounded kidney, smooth, glossy, light yellow to intensely yellow. Pure variety seeds Gold Medal 7, of the same size, are selected. They are disinfected with a 70% alcohol solution and then very well washed with water.

Sprouted seeds are sown at a depth of 2 cm in polyethylene buckets containing 0,5 kg of soil. After germination, two plants are left in the vessels in each bucket. They are watered every day and are kept at a constant temperature of 20 ^{0}C. The nursery period for early Polish production is 85 days. After this period, the plants are grafted to continue vascular trials.

3. Results

Soil production for sowing

The soil is treated at 30-32 cm deep, well homogenized, dried and sifted through a sieve of 2 mm and a chemical analysis has been carried out. The soil is mixed with quartz sand in a ratio soil: sand 25:100. A lack of heavy metals above the limit concentrations and insufficient nutrients in the soil itself have been found. Mixing with the sand is done to mimic poor soil, with measured pH = 7.2.

Loading of vascular experiments.

For the vegetation experiments, plastic containers measuring h= 140 mm x d=166 mm were used. In each container is placed in an equal amount of soil - 1 kg. (1.1s and 5.1s) Each mixture is placed 50 g in a container. The control without improver a code 0 was also planted.

Vegetation experiment

In the initial period, pepper has slow growth. It sprouts for 7-8 days. Until the formation of the first actual leaves pass 25-30 days. The entire seeding period is 85 days, after which they undergo vegetation vascular trials and are grafted into poor soil. The variety has a long growing season of about 65 days. Pepper plants bloom throughout the growing season. The formation of fruits strongly decreases when the first fruits are not picked in a timely manner. For the purposes of vegetation experiments, pepper has not been torn off in a timely manner. The duration of the vegetation tests shall cover 100 days and shall include the fertility period. In the process of taxonomy, diameter and height of the stem, total number of leaves and flowers, number and size of fruits were observed and measured. The recording of the parameters is carried out by direct observations and direct weekly measurements. Further data processing was carried out on the basis of a comparison of the reported taxonomic data, with the results averaging from the three vessels for each sample [14].

Botanical feature of the leaf mass

The leaves are simple, with handles. The leafy petura in shape is elliptical to a lancet and with a pointed tip. The leaves are located individually. The following Figures 1 and 2 show the evolution of the leaf mass during the 100 days of vegetation development, with a summary picture of powder and tablet form for each mixture compared to the zero sample, which is the control for the development of the leaf mass.

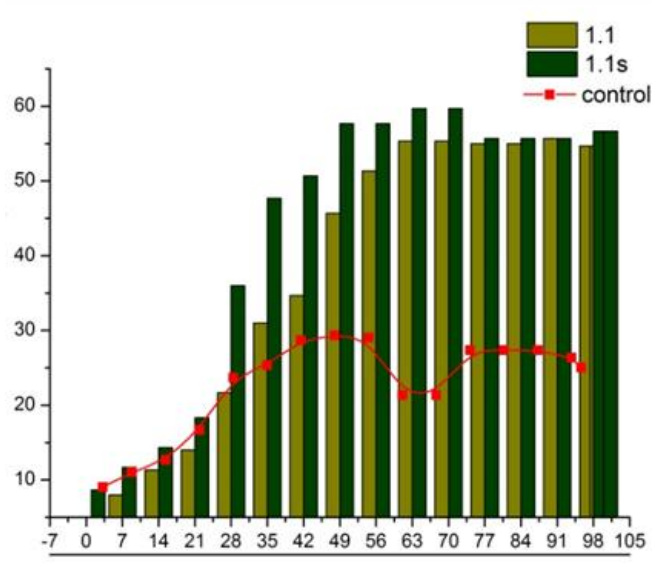


Fig. 1 *Development of leaf mass in powder and tablet form of a mixture 1.1 X - days, Y- number of leaf mass*

In mixture 1.1 from the beginning, the leaf mass in plantations nourished with powder form develops faster, and from the 28th to the 70th day this is the most intense, then equalizes with the leaf mass of the plants nourished their tablet form. The leaves are light green and withstand high and low temperatures for the season At a mixture of 5.1 to the 28th day, the two forms of the mixture move in the same range of leafing, with a slight preponderance of the tablet shape. The leaves are the same colour as in the 1.1 mixture, but have a greater sensitivity to temperature changes and at the end of the growing season there is less leaf mass than 1.1.

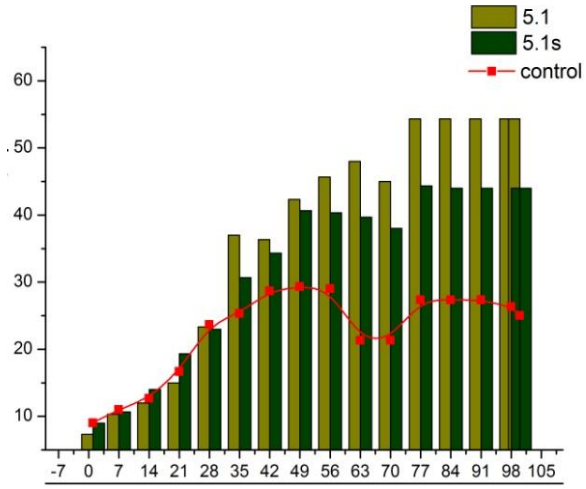
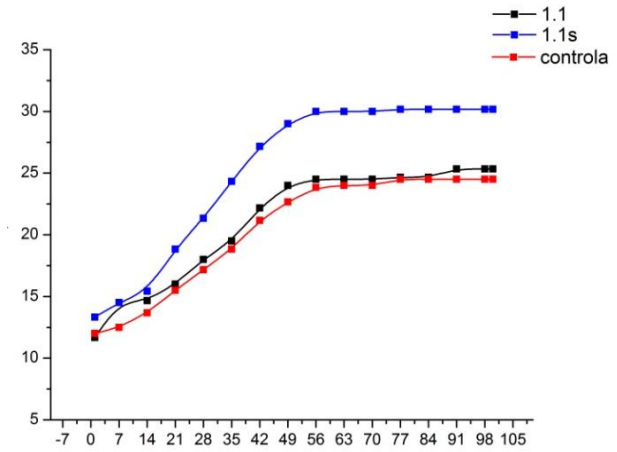


Fig.2 *Development of leaf mass in powder and tablet form of a mixture 5.1 X - days, Y- number of leaf mass*

Botanical feature of the stem mass

The stem was originally herbaceous. As vegetation progresses, its lower part gradually stiffens. It is healthy and sustainable. It remains upright and after a load of fruit. The stem branches after the first dozen leaves. Forms between two or four main branches. Each branch forms two new ones, which are different in length and thickness. Stronger branches form the main axes of the plant. Until the first branching from the pavement buds of the leaves do not grow side branches.

The following figures (3 and 4) illustrate the development of the stem mass in height and thickness of the stem. During the 100 days of vegetation development, a summary picture of powder and tablet form was taken for each mixture, compared to the zero sample, which is the control for the development of plants



Фиг.3 *Height of stem mass (in mm) of powder and tablet form of mixture 1.1. Coordinate X - number of leaf mass, Y - days*

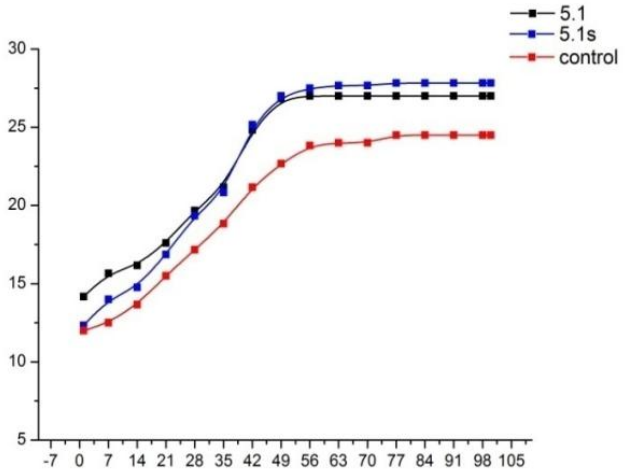


Fig. 4 *Height of stem mass (in mm) of powder and tablet form of mixture 5.1. Coordinate X - number of leaf mass, Y - days*

The height of the stem varies from 25 to 31 cm and the height of the stem of the control is 24 cm. In mixtures 1.1, there is a significant difference in the growth of the stem mass depending on the shape of the imported nourishing substances, with a higher growth of the stem in the powder form. At 5.1, a significant difference in growth between the two forms was not observed. Depending on the angle at which the branches come out, plants with a tucked or scattered habitat are formed. In the conducted experience, all plants have a sprawling habitat. The thickness of the stem is about 6 mm.

Botanical feature of the root system

The root system is bearded. The main root is short and strongly branched. The main part of the roots are located at a depth of 140 mm and a width of 116 mm in diameter around the plant.

With the relatively shallowly located root system can explain the great requirements of this plant to the mechanical composition of the soil, its humidity and nutrient content. In sample 1.1 in both forms of nourishment, the root system is highly developed, as in the tablet form the granules are woven into the root system and are whole. Mixture 5.1 also has a very robust and highly developed root system with tightly woven tablets in them.

Botanical characteristic of colors and fruits

The experiment at lasted 45 days. At the end of the experiment, there were no surviving plants in the control samples. Data tracking plant development are summarized in **Table 1**.

Fig.6. *Taxonomy, 100th day – control sample*

Table 1. *Plant development*

Days	Control	1.1	1.1s	5.1	5.1s
1	1 bud		2 buds	0.6 buds	2 buds
7	2.6 buds	2.3 buds	3 buds	2.6 buds	3 buds
14	3 buds	3.3 buds	3.6 buds 2 colors	3.3 buds	2 buds
21.	1.5 buds 2 colors	4.3 buds 1.3 colors	5.3 buds 5.3 buds	6 buds	3.3 buds 2 colors
28	1.5 buds 2.5 colors	7 buds 2 colors	4 buds 6 colors 1 small fruit	7 buds 3.6 colors	5.3 buds 2 colors
35.	3 colors 1 small fruit	5.6 buds 5 colors	3.6 buds 7 colors 1 fruit-4 cm	5.3 buds 4.3 colors	3.6 buds 3.6 colors
42	3.6 colors 1 fruit – 3 cm	8 buds 6.6 colors 1 fruit – 1.4 cm	1 bud 3.6 colors 1 fruit-7.6 cm	4 buds 7.3 colors	5 colors 1 fruit - 6 cm
49	1 fruit – 4 cm	6.6 colors 4 buds 1 fruit – 2.5 cm	1 fruit-4 cm 1 fruit-9.5 cm	3 buds 8.3 colors	3 colors 1 fruit – 7.7 cm
56	1 fruit – 5 cm	1.6 colors 1 fruit –5.2 cm	1 fruit-4.5 cm 1 fruit-10.8 cm	7.6 colors 1 fruit	1 fruit – 9.8 cm
63	1 fruit – 5.5 cm	1 color 1 small fruit 1 fruit–7.4 cm	1 fruit-5 cm 1 fruit-11.2 cm	8 colors 1 fruit – 5.5 cm	1 fruit – 10.3 cm
70.	1 fruit – 7.3 cm	1 color 1 small fruit 1 fruit–8 cm	1 fruit-5.3 cm 1 fruit-11.8 cm	2.3 colors 1 fruit – 7.3 cm	1 fruit – 11.3 cm
77.	1 fruit – 7.3cm	1 color small fruit fruit–9.3 cm	4 buds 6 colors 1 small fruit	1 fruit – 8 cm	1 fruit – 11.5 cm
84.	1 fruit – 8 cm	1 color small fruit fruit–9.8 cm	fruit-5.5 cm fruit-12.3 cm	1 fruit – 9.5 cm	1 fruit – 11.5 cm
91.	1 fruit – 8 cm	1 color small fruit fruit–10.3 cm	fruit-5.5 cm fruit-12.6 cm	fruit – 10 cm	fruit – 12 cm
98	1 fruit – 8.5 cm	1 color small fruit fruit–10.5 cm	fruit-5.5 cm fruit-13.4 cm	fruit – 10 cm	fruit – 12 cm

In the process of growth in the first week of vegetative trials, the presence of first buds in the control and mixture 5.1 was noted. in the second week all mixtures have almost leveled amounts of buds as in the 21st day. Over the next week, taxonomy results are again leveled for all mixtures. Between the 49th and 56th days, all mixtures are already indicated in the process of fruit formation. The growth of the control over the others is slower, with mixtures of 5.1 when the fruits are fully ripened, the pepper sizes of 8 to 13.4 cm are reached at 1.1s. Figures 5 and 6 show the final results of the vegetation experiment of the zero sample and mixture 1.1

Fig.5 *Taxonomy, 100th day - mixture 1.1 respectively tablet (right) and powder (left) form*

Conclusion

From the taxonomic measurements carried out at the end of the vegetation experiments for each plant, the indicators for the stem and leaf mass, the root system and the fruit were determined. The results of the study prove the ability to use soil improvers, good resistance of the leaves to sudden intense changes in climatic conditions. The root systems of all mixtures are well developed and strong, stable with good agrochemical parameters compared to that of the zero sample.

4. References

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