Turkish Journal of Agricultural and Natural Sciences
Special Issue: 2, 2014

TÜRK
TARIM ve DOĞA BİLİMLERİ
DERGİSİ

TURKISH
JOURNAL of AGRICULTURAL
and NATURAL SCIENCES

www.turkjans.com

# Influence of Pre-Sowing Electromagnetic Treatment on Some Main Characters of Economic Characteristic of Head Cabbage

[a]Galina ANTONOVA[*], [a]Miroslav MIHOV, [a]Sofia DECHEVA, [b]Kiril SIRAKOV, [b]Svetoslav ZAHARIEV, [b]Ivan PALOV
[a] Maritsa Vegetable Crops Research Institute, Plovdiv 4003 – BULGARIA
[b] University of Ruse "Angel Kanchev", Ruse 7017 - BULGARIA
[*]Corresponding author: galjaant@abv.bg

**Abstract**

A pre-sowing electromagnetic treatment of cabbage standard dry seeds from variety Balkan was carried out in the AC corona discharge field. The full planned experiment $2^2$ type was performed in four variants of treatment with selected values of controllable factors: voltage **U**=20 and 10 kV, duration of treatment **τ**=10 и 30 s and length of stay of sowing seeds to 33, 26, 19, 12 and 5 days.

It was established that the variants with pre-sowing electromagnetic treatment in the AC corona discharge field have a different effect on the studied characters and positive and negative influences of stimulation and reduction of the character values were observed. In this investigation of interest were the electromagnetic treatments with **U**=20 kV and **τ**=30 s and **U**=20 kV and **τ**=10 s in stay after seed treatment respectively 12 and 19 days that demonstrated the most significant effects to increase the cabbage weight and the yield from total and standard produce. In these expositions, the cabbage weight exceeded that of the control with 29-30 % as it was registered total and standard yield higher with 20-21 % and 24-27 % towards those obtained in the control variant. Considerable increase of the standard yield with 25 % was reported also in variant with treatment **U**=10 kV and **τ**=10 s and stay of the seeds for 12 days. A decrease of vegetation period with 5-7 days was observed in these variants of electromagnetic impact.

**Keywords:** AC Corona Discharge Field, Electromagnetic Treatment, Head Cabbage, Vegetation Period, Weight, Total Yield, Standard Yield

## Introduction

An improvement in economic characteristic of the crops is one the main priorities in the modern agriculture as new alternative decisions are searched for stimulation of the biological potential expression of the crops for realization. In this aspect the studies concerning the pre-sowing treatment of the seeds resulting in an increase of energy balance, acceleration or modifying of the growth and development processes (Kurinobu and Okazaki, 1995; Davies, 1996; Celestino et al., 2000; Vasilevski, 2003) and higher productivity registration (Palov et al., 2005; Grzegorz and Leszek, 2006) are of importance. It was established a positive effect of electromagnetic energy application in different crops according to Balouchi and Modarres Sanavy (2009), Palov et al. (2012), Inozemcev (2013) etc.

The purpose of the present study was to determine the effect of pre-sowing electromagnetic processing in the AC corona discharge field on the duration of vegetation period, cabbage head weight and total and standard yield of head cabbage variety "Balkan".

## Material and Methods

An electromagnetic processing of standard dry seeds from head cabbage of variety "Balkan" in the field of AC corona discharge, created between the electrodes edge-plane (Palov, 1980) was carried out in the period 2012 – 2013 in the

University of Ruse "Angel Kanchev". The full planned experiment $2^2$ type was performed in four variants of treatment, in fixed value of the high voltage **U** and specific duration $\tau$ (Table 1) and control variant – untreated seeds. The duration of the seed stay (T) after the expositions in each one of the studied variants with electromagnetic impact was 33, 26, 19, 12 and 5 days.

The field experimental work was conducted in the "Maritsa" Vegetable Crops Research Institute, Plovdiv. All studied treatments were set in 4 replications (100 seeds/ replication) as the seed sowing was performed on the 18th of June on open field plot for seedlings production. The plants were sown on the 30th of July by scheme 90+70\60 cm on high flat bed (20830 plants/ha). The sowing was grown by standard technology for late field production of head cabbage as all variants of study were set in 4 replications (22 plants per replication).

**Table 1.** Experimental planning matrix

| Treatments | Voltage (U) | | Duration of impact ($\tau$) | |
|---|---|---|---|---|
| | level | kV | level | s |
| 1 | +1 | 20 | +1 | 30 |
| 2 | -1 | 10 | +1 | 30 |
| 3 | +1 | 20 | -1 | 10 |
| 4 | -1 | 10 | -1 | 10 |

It was studied the following characters: length of vegetation period from transplanting to harvesting (days), head cabbage weight (кg), total yield (t $ha^{-1}$) and standard yield ( t $ha^{-1}$). The analysis of character head cabbage weight was made by biometrical measurements of 10 plants per replication. Data for the characters vegetation period length, total yield and standard yield were recorded after analyzing of all plants from each replication.

The obtained data were processed mathematically and by analysis of variance (Lakin, 1990) and the significance of differences by comparison with the control was determined by the LSD test using Student's *t* – test.

**Results and Discussion**

Different effects of pre-sowing electromagnetic processing on the studied characters from the economic characteristics of head cabbage were established in the performed study (Table 2). The effect of the electromagnetic field was the lowest in relation to the length of the vegetation period as values similar to the recorded for the control were observed in predominant part of the studied variants. It was observed an useful effect concerning vegetation period decrease with 5-7 days (7- 8 %) for variant 1 at T=12 days, variant 2 at T= 5 days, variant 3 where the seeds stay was 19 and 5 days and variant 4 with T= 12 days (Figure 1). In this character the shorter stay of the seeds after the electromagnetic processing has a positive effect on decrease of the vegetation length in head cabbage. Regarding the head cabbage weight the effects of treatment in electromagnetic field are contrast (Figure 1). It was registered values from 2.713 кg – 2.963 кg (variant 1, 2 and 4 at T=12 days and variant 3 with T=19 days) that exceeds the control with 20 to 30 % as well as such ones from 1.525 кg and 1.155 кg (variants 2 with T=19 and variant 4 with T=26 days) that are with 33 % and 50 % lower compared to the recorded for character in the control variant of study.

Effect similar to the recorded ones for the head cabbage weight were also observed for the characters total and standard yield (Figure 1). The highest total yield 57.750 t $ha^{-1}$ and 58.250 t $ha^{-1}$ was recorded for the variants of electromagnetic treatment 1 and 3 with stay of the seeds 12 and 19, respectively as the amount of total produce exceeds the produce form the control variant with 20 % - 21 %. The yield of total produce was the lowest 26.400 t $ha^{-1}$ and 28.750 t $ha^{-1}$ in variants 4 with T=26 days and 2 with T=19 days or this presents 55 % - 60 % from the realized total yield from the control variant.

**Table 2.** Characters of economic characteristic of head cabbage

| Variants | Duration of seed stay | Vegetation period | Head cabbage weight | Total yield | Standard yield |
|---|---|---|---|---|---|
| | days | days | кg | t ha$^{-1}$ | t ha$^{-1}$ |
| control | - | 90 | 2.263 | 48.100 | 42.000 |
| 1 | 33 | 90 $^{ns}$ | 1.755*** | 36.750** | 26.500*** |
| | 26 | 87** | 2.418*** | 49.900 $^{ns}$ | 45.000 $^{ns}$ |
| | 19 | 92.5** | 1.933*** | 38.000** | 35.400* |
| | 12 | 82.5*** | 2.963*** | 57.750** | 53.750** |
| | 5 | 93** | 1.550*** | 31.000*** | 26.100*** |
| 2 | 33 | 90.5 $^{ns}$ | 1.750*** | 36.000** | 32.900* |
| | 26 | 90 $^{ns}$ | 1.888*** | 39.000** | 35.750* |
| | 19 | 90 $^{ns}$ | 1.525*** | 28.750*** | 26.250*** |
| | 12 | 87.5** | 2.763*** | 53.500* | 49.800* |
| | 5 | 85*** | 2.625*** | 52.250 $^{ns}$ | 47.650* |
| 3 | 33 | 90.5 $^{ns}$ | 2.033*** | 41.750* | 37.150 $^{ns}$ |
| | 26 | 92.5** | 1.838*** | 37.000** | 35.400* |
| | 19 | 84.5*** | 2.935*** | 58.250** | 52.250* |
| | 12 | 87** | 2.400*** | 43.250* | 39.400 $^{ns}$ |
| | 5 | 84*** | 2.570*** | 48.000 $^{ns}$ | 45.350 $^{ns}$ |
| 4 | 33 | 92.5** | 2.198 $^{ns}$ | 42.000* | 39.000 $^{ns}$ |
| | 26 | 95*** | 1.155*** | 26.400*** | 22.050*** |
| | 19 | 92.5** | 2.125*** | 43.250* | 39.500 $^{ns}$ |
| | 12 | 84.5*** | 2.713*** | 55.750* | 52.900** |
| | 5 | 87.5** | 2.355* | 49.850 $^{ns}$ | 46.050 $^{ns}$ |
| *LSD* $_{0.05}$ | | *1.79* | *0.078* | *4.329* | *5.029* |
| *LSD* $_{0.01}$ | | *2.38* | *0.104* | *9.049* | *10.825* |
| *LSD* $_{0.001}$ | | *3.087* | *0.134* | *13.314* | *15.501* |

*,**,*** significant at level of p≤0.05, p≤0.01, p≤0.001; $^{ns}$ – non significant

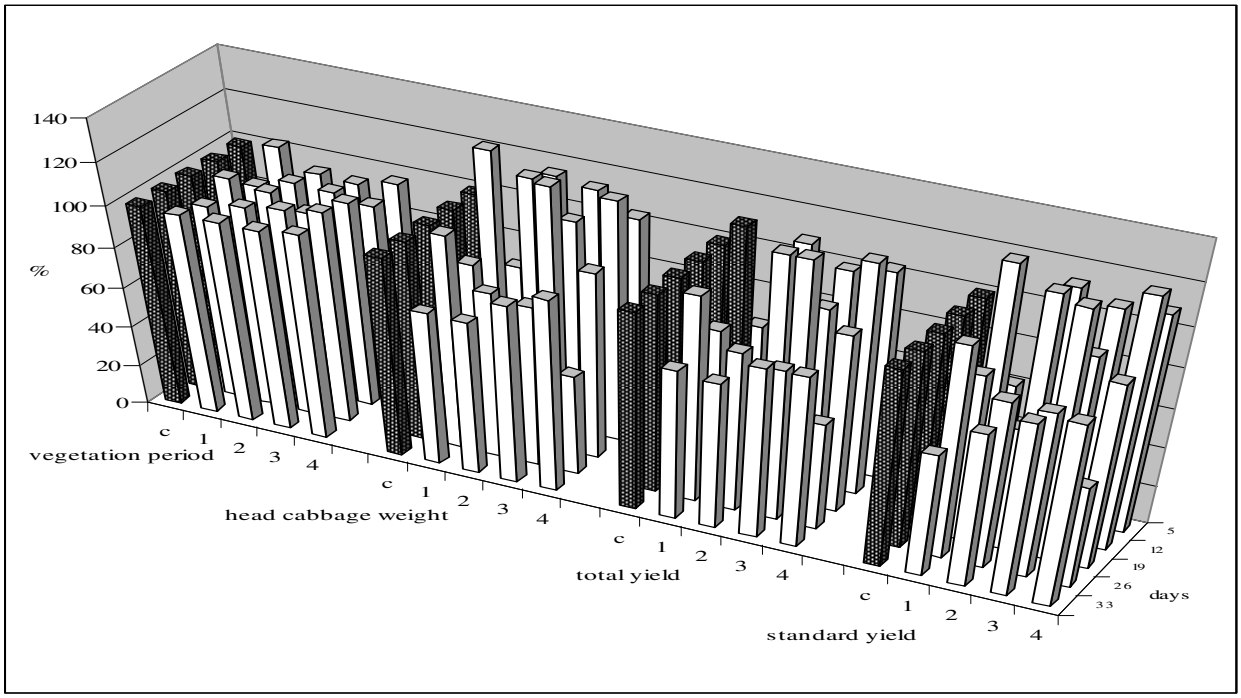


**Figure 1.** Influence of electromagnetic treatment on characters of economic characteristic of head cabbage (c – control; 1,2,3,4 - variants of treatment)

The indicated variants of electromagnetic treatment limit in a certain degree also the values of the standard yield. The greatest amount of standard produce 52.250 t $ha^{-1}$- 53.750 t $ha^{-1}$ is obtained in variants 1 and 4 when the stay of seeds is 12 days and in variant 3 with T=19 days which exceed the control variant with 24 % - 27 %. Minimal yields from standard produce 22.050 t $ha^{-1}$ and 26.610 t $ha^{-1}$ - 26.650 t $ha^{-1}$ are recorded for variant 4 with T=26 days, variant 1 with T= 33 and 5 days and variant 2 with T= 19 days as this produce is 52 % - 63 % from the realized total yield in the control variant of study.

The comparative analysis of the obtained results demonstrates that the pre-sowing electromagnetic treatment of seeds from head cabbage in AC corona discharge field has a different influence on the studied characters. Positive and negative effects of stimulation and reduction of the character values are observed for head cabbage weight and yields from total and standard produce. In this investigation manifestations identical to those recorded for the control variant are registered only for the vegetation period. In economic aspect the most significant effects are observed in increase of the head cabbage weight and yields from total and standard produce obtained as a result of the electromagnetic treatment with **U**=20 kV and $\tau$=30 s (variant 1) and **U**=20 kV and $\tau$=10 s (variant 3) when the stay of the seeds after treatment have been 12 and 19 days, respectively. In these expositions the head cabbage weight exceeds the recorded one for the control with 29 – 30 % and the registered total and standard yields are higher with 20 - 21 % and 24 - 27 % towards those realized for the control. It is recorded a significant increase of the standard yield with 25 % in treatment with **U**=10 kV and $\tau$=10 s (variant 4) and stay of the seeds after treatment for 12 days. In these variants of electromagnetic impact, the registered decrease of the vegetation period with 5-7 days is also of importance.

It makes an impression in this study, that in shorter stay of the seeds after exposition the positive influence of the electromagnetic field is relatively stronger expressed on the studied characters from the economic characteristics of the head cabbage.

The results obtained in this study could be of interest for the practice. They could be used for development of scientifically founded technological decisions for enhancement of the

biological potential of the crop. However in future studies it is necessary also to determine the effect of genotype in pre-sowing electromagnetic treatment as the varieties that will be tested should be with different genetically determined possibilities for realization.

***Conclusion***

The pre-sowing electromagnetic treatment of seeds from head cabbage in the AC corona discharge field has a different effect on the characters from the economic characteristics of the crop. It is observed positive and negative influences of stimulation and reduction of the character values.

Positive effects are registered for the variants of electromagnetic treatment with **U**=20 kV and $\tau$=30 s and stay of the seeds after treatment for 12 days as well as in treatment with **U**=20 kV and $\tau$=10 s and seeds stay after treatment for 19 days as a result of which the head cabbage weight is increased with 29 – 30 %, and total and standard yield with 20 - 21 % and 24 - 27 %. An increase of the standard yield with 25 % is recorded also in treatment with **U**=10 kV and $\tau$=10 s and stay of the seeds after treatment 12 days. In these variants of electromagnetic treatment, a decrease of vegetation period with 5-7 days is registered.

A strong negative effect on the studied characters is observed in the variants with electromagnetic treatment with **U**=10 kV and $\tau$=10 s in stay of the seeds for 26 days after exposition and in variant of treatment with **U**=10 kV and $\tau$=30 s and stay of the seeds for 19 days. The values of the head cabbage weight, total and standard yield are with 33 to 48 % lower in these pre-sowing treatments compared to those recorded for the variants with untreated seeds while the period of vegetation is identical or longer compared to that of the control treatment.

**References**

Balouchi, H.R. and Modarres Sanavy, S.A.M., 2009. Electromagnetic field impact on annual medics and dodder seed germination. *International Agrophysics* 23, 111-115.

Celestino, C., Picaza, M.L. and Toribio, M., 2000. Influence of Chronic Exposure to an Electromagnetic Field on Germination and Early Growth of Quercus Suber Seeds: Preliminary Study. *Electro and Magnetobiology*, 19, (1), 115-120.

Davies, M.I., 1996. Effects of 60Hz electromagnetic field on early growth in three plant species and a replication of previous results. *Bioelectromagnetics* 17,154-161.

Grzegorz, S. and Leszek, R., 2006. Influence of electromagnetic field on yielding and quality of naked and hulled spring barley and oat. *Acta Agrophysica*, 8, (2), 501-508.

Inozemcev, G.B., 2013. Impact of electromagnetic energy on the increasing yield capacity and growth stimulation of plants. *Annals of Warsaw University of Life Sciences – SGGW*, Agriculture 62, 31–35.

Kurinobu, S. and Okazaki, Y., 1995. Dielectric constant and conductivity of one seed in germination process. *Proceedings of the Annual Conference Record, Institute of Electrical and Electronics Engineers/Industry Applications Society*, December 8-10, Orlando, 1329-1334.

Lakin, G., 1990. Biometria. Vishaja Shcola, Moskva, 395 pp (in Rusian)

Palov, Iv., Kuzmanov, E., Sirakov, K., Stefanov, St. and Neykov Y., 2012. Rezults from a preliminary research on the pre-sowing electromagnetic treatment of rape seeds. *Agronomy Research*, 10 (1-2), 335-340.

Palov, Iv., Sirakov, K., Nikolova, G., Mitev, Pl. and Hristov G., 2005. Pre-sowing electromagnetic seed treatment impact on maize hybrid yield. Agricultural engineering, *Proceeding of the International Conference'' New technological Processes And Investigation Methods For Agricultural Engineering''*, Raudondvaris, Lithuania, 10, 327-334.

Palov, Iv., 1980. Study on the possibilities for accelerating of process for drying of grass mass by its treatment in the AC corona discharge field. *PhD Thesis*, Ruse, 184 pp (in Bulgarian)

Vasilevski, G., 2003. Perspectives of the application of biophysical methods in sustainable agriculture. *Bulgarien Journal of Plant Physiology*, Special issue, 179–186.