**THE GERMINATION OF PEA PLANTS UNDER THE PRE-SOWING TOCOFEROL TREATMENT**

**Kolesnikov M., PhD**

*Dmytro Motornyi Tavria state agrotechnological university,*

*Zaporizhzhia*

*е-mail:* [*maksym.kolesnikov@tsatu.edu.ua*](mailto:maksym.kolesnikov@tsatu.edu.ua)

Peas (*Pisum sativum* L*.)* are the main leguminous crop in Ukraine. The pea seeds contains up to 34% protein, up to 54% carbohydrates, 1.6% fat, starch, sugars, vitamins, carotene, minerals, which determines its high nutritional and fodder value, in general. The pea plants have a good quality indicator and a relatively short growing season. Peas are characterized by symbiotic fixation of atmospheric nitrogen, which provides 30-35% of the plant's own needs. The sown area of peas in Ukraine was 350-500 thousand hectares last years. The average yield of peas in Ukraine is 17.2 t/ha [1,2].

To increase crop productivity, vegetative mass and product quality when growing peas, it is recommended to use preparations that stimulate growth processes. According to the references, the use of tocopherol as a biostimulant with antioxidant action in the cultivation of agricultural crops influenced on yield [3].

The aim of the work was to determine the influence of tocopherol and its complex with dimethyl sulfoxide on the peas germination.

The design of the experiment included nine groups in four-times replicas. The seeds of the control variant were soaked for 6 hours in water, the seeds of the experimental variants - in solutions of tocopherol in concentrations of 0.1 and 0.4 g/l, DMSO - 0.1 and 1.0%, mixtures - TPh 0.1 g/l + DMSO 0.1%, TPh 0.1 g/l + DMSO 1.0%, TPh 0.4 g/l + DMSO 0.1%, TPh 0.4 g/l + DMSO 1.0%.

The seeds of pea Gotivskyi variety (F1) were used to study the effect of preparations. Pea seeds were placed at growth chamber conditions with a temperature regime of 24 ± 2°C in the dark. Seeds of the control and drought treatments were germinated according to the International Seed Testing Association (ISTA) protocol. For each treatment 200 seeds were placed on four 90 mm diameter Petri dish (50 seeds on each dish) [4]. The laboratory germination (LG), raw weights of roots and seedlings, and length of roots and seedlings of pea were measured on the 7th day after sowing. All measurement represents the means and standard error (±SE) of five replicas. Statistically significant differences between means were compared at the 0.05 probability level by t–Student’s test [5].

It is generally known that the formation of the future harvest begins at the stage of seed germination and emergence. Therefore, pre-sowing treatment of agricultural crop seeds with complexes of fungicides, trace elements, inoculants, and anti-stress agents allows to increase the efficiency of production significantly [3]. Tocopherol, as a fat-soluble antioxidant, is difficult to transport separately to the cells of the plant organism, but in solubilized form and with the addition of DMSO elicitor, its inclusion in metabolic processes becomes effective.

Germination of peas for 7 days showed that α-TF, DMSO under the conditions of separate or combined pre-sowing seed soaking caused changes in morphometric indicators. Thus, the laboratory germination of pea seeds treated with TPh at a concentration of 0.1 g/l did not change reliably compared to the control (Table 1). Whereas, TPh in 0.4 g/l concentration increased seed germination by 7.0%. It was noted, that DMSO in the studied concentrations also increased germination of pea seeds. The use of complex TPh and DMSO in different concentration ratios increased the laboratory germination of seeds by 5.0-6.0% compared to untreated seeds. It wasn`t noted the increasing in seed germination when soaking seeds in a complex solution with high concentrations.

Table 1 - Laboratory germination of pea seeds, length of pea roots and seedlings under the tocopherol and DMSO pre-sowing treatment

|  |  |  |  |
| --- | --- | --- | --- |
| Variant | Laboratory germination, % | length, mm | |
| seedlings | roots |
| Water (control) | 83,0±1,0 | 26,2±0,7 | 66,4±1,7 |
| TPh 0,1 g/L | 82,0±2,2 | 31,2±0,8\* | 62,3±1,6 |
| TPh 0,4 g/L | 90,0±2,9\* | 32,1±0,8\* | 64,8±1,7 |
| DMSO 0,1% | 85,0±3,1 | 29,4±0,7\* | 69,3±1,4 |
| DMSO 1,0% | 87,5±3,6 | 25,0±0,6 | 60,3±1,4\* |
| TPh 0,1 g/L + DMSO 0,1% | 89,0±2,6\* | 29,7±0,7\* | 74,0±1,7\* |
| TPh 0,1 g/L + DMSO 1,0% | 89,0±2,6\* | 27,2±0,6 | 71,3±1,7\* |
| TPh 0,4 g/L + DMSO 0,1% | 88,0±0,8\* | 30,1±0,8\* | 69,5±1,6 |
| TPh 0,4 g/L + DMSO 1,0% | 82,5±1,3 | 30,8±0,7\* | 64,2±1,4 |

If TPh and DMSO increased the weight of the roots in the bigger rate than the seedlings, so a probable increase in the length of the seedlings was found when the studied preparations were used separately. Pre-sowing treatment of pea seeds with a complex of TPh with DMSO in different concentrations increased the growth of seedling length from 4% to 18%, and root length from 5% to 12% compared to the plants without pre-sowing treatment. The complex of TPh 0.1 g/L and DMSO 0.1% most effectively stimulated the growth of pea seedlings.

It can be seen from the data presented in Table 2, that TPh in the studied concentrations increased the raw weight of seedlings and roots by 9.6% and 17%, respectively, and compared to the control indicators. The DMSO solution quite effectively stimulated the accumulation of the raw weight of pea roots by 32% - 42%. The complex of TPh and DMSO probable increased the raw weight of pea seedlings and roots. The complex TPh 0,1 g/L + DMSO 1,0% was the most effective and increased the raw weight of seedlings by 27% and roots by 47%.

TPh and DMSO, when used separately and when used as a complex, increased the dry weight of seedlings and roots of pea. It was shown the maximum increase of the dry weight of seedlings by 15.3% and of roots by 36.1% compared to the control plants when pea seeds were treated with a complex TPh 0,1 g/L + DMSO 1,0%.

Table 2 - Raw and dry weight of pea seedlings and roots under the pre-sowing treatment with tocopherol and DMSO, g ̸100 pcs.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variant | Raw weight | | Dry weight | |
|  | seedlings | roots | seedlings | roots |
| Water (control) | 10,4±0,1 | 17,2±0,8 | 1,051±0,024 | 1,350±0,102 |
| TPh 0,1 g/L | 11,4±0,3\* | 21,8±0,9\* | 1,119±0,038 | 1,612±0,083 |
| TPh 0,4 g/L | 11,4±0,4\* | 20,1±1,0\* | 1,113±0,044 | 1,549±0,066 |
| DMSO 0,1% | 11,5±0,4\* | 24,4±0,3\* | 1,138±0,024\* | 1,894±0,013\* |
| DMSO 1,0% | 10,9±0,5 | 22,7±1,1\* | 1,035±0,047 | 1,673±0,067\* |
| TPh 0,1 g/L + DMSO 0,1% | 11,1±0,2\* | 23,9±0,9\* | 1,101±0,020 | 1,847±0,049\* |
| TPh 0,1 g/L + DMSO 1,0% | 13,2±0,6\* | 25,3±0,8\* | 1,212±0,037\* | 1,837±0,060\* |
| TPh 0,4 g/L + DMSO 0,1% | 12,3±0,3\* | 20,8±1,3\* | 1,203±0,043\* | 1,552±0,076 |
| TPh 0,4 g/L + DMSO 1,0% | 12,9±0,4\* | 21,4±0,5\* | 1,219±0,032\* | 1,570±0,038 |

Conclusions. Analysis of the results showed that the studied complexes based on TPh stimulated the growth processes during pea germination. The most effective was complex of TPh 0.1 g/l + DMSO 0.1%, according the stimulation effect on germination, morphometric indicators of seedlings and roots.

**References**

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