DOI: https://doi.org/10.53040/cga12.34 UDC: 633.15:631.53.027.32

IMPACT OF NON-OPTIMAL TEMPERATURE AND BIOREGULATOR ON ROOT AND SEEDLING VIGOUR OF CORN

Raisa IVANOVA[1], ORCID: 0000-0002-2554-2039
raisa.ivanova@sti.usm.md
Elena LUTCAN[1], ORCID: 0000-0001-9967-6665
Nicolai VANICOVICI[2]
Ala BOROVSKAIA[1], ORCID: 0000-0002-7225-0186
Dina ELISOVETCAIA[1], ORCID: 0000-0003-0521-6428

[1]Institute of Genetics, Physiology and Plant Protection, Moldova State University, Chisinau, Republic of Moldova
[2]National Center of Research and Seed Production, "Porumbeni" Institute of Crop Science, s. Pascani, Republic of Moldova

Abstract. *Take into account that the corn vigour has the strong correlated field emergence and yield, the purpose of this work was to evaluate the combined influence of non-optimal temperatures and a natural bioregulator on the vigour of corn root and seedling. The seeds of Porumbeni 455 corn hybrid pre-treated with natural bioregulator (JS) extracted from Juniperus sabina were subjected to treatment at 50°C (heat test) and at 10°C (cold test). The vigour of root and seedling was assessed after seed germination. Temperature above the optimum significantly affected both the vigour of root and the vigour of seedling, but temperature below the optimum only reduced the root vigour of the tested corn hybrid. The JS bioregulator contributed to an increase in root system vigour. Corn seeds pre-treated with JS had root vigour greater than untreated ones by 13.08 and 18.46%, respectively in the cold and heat test. The evaluation of factor impact showed that the temperature influenced both the root and seedling vigour more than the treatment with the bioregulator, and their combined effect significantly modified only the root vigour.*

Keywords: bioregulator, cold test, corn, heat test, germination, vigour.

INTRODUCTION

The corn vigour determined in laboratory condition strong correlated with both the laboratory overall germination (0.93-0.99) of corn seed and their field emergence (0.82) [1, 2]. Thus, the vigour of corn seeds predicts a higher rate and uniformity of emergence in the field, as well as crop yield. It is well known, that seedling emergence can be affected by many abiotic factors such as high or low temperatures, water deficit, etc. [3]. However, the pre-treatment with plant growth regulators can induce a rapid adaptive response to stress conditions [4, 5], including the non-optimal temperature. Therefore, the aim of this work was to evaluate the

combined influence of non-optimal temperatures and a natural bioregulator on the vigour of corn root and seedling.

MATERIALS AND METODS

Corn seeds of hybrid Porumbeni 455 (P455) that belongs to the FAO 450 corn group and has dent grain were tested. Weight of 1000-grain is 330-340 g. ***Laboratory testing.*** Seeds were pre-soaked for 24 hours in water or in solution with concentration 0.0001% of natural bioregulator (JS) obtained from aerial part of plant *Juniperus sabina* L. [6]. Then seeds were subjected to heat treatment at 50°C for 30 minutes (heat test) or to cold test. Germination of intact (control) and heated seeds was carried out in accordance with the international rules [7]. To conduct the cold test, seeds were germinated for seven days at temperature of 10°C, and then 4 days at 25°C [8]. The overall seed germination, root/seedling length, root/seedling vigour was assessed [9]. ***Statistical analysis*** was performed by Statgraphics Plus 5.0 software.

RESULTS ANS DISCUSSIONS

Treatment of control seeds with the bioregulator JS did not contribute to an increase in roots vigour. The average values of root vigour of intact and JS-treated seeds differed insignificantly (Fig. 1). However, the root vigour of corn seeds subjected to both heat and cold tests decreased significantly ($p \leq 0.001$) compared to the control seeds. The positive effect of JS treatment on the increase of root vigour was evaluated after heat and cold test with the difference values of 76.55 (cold-test) and 100.92 (heat-test) (Fig. 1). Thus, the corn seeds pre-treated with JS had roots vigour greater than the untreated ones by 13.08 and 18.46%, respectively in the cold and heat test.

In growth conditions with non-optimal temperatures, the use of pre-treatment of corn seeds with JS natural bioregulator leads to an increase in the vigour of the root system, which is very important for the early phase of corn growth and its adaptation to stressful conditions. Treatment of control seeds with JS also resulted in an increase in seedlings vigour by 20.78% (Fig. 2). It should to be noted, that the cold test itself had a positive effect ($p \leq 0.001$) on the seedling vigour of germinated seeds without JS treatment. However, no significant impact of JS treatment was found on the seedlings vigour of the P455 corn seeds subjected to both the heat and cold tests (Fig. 2).

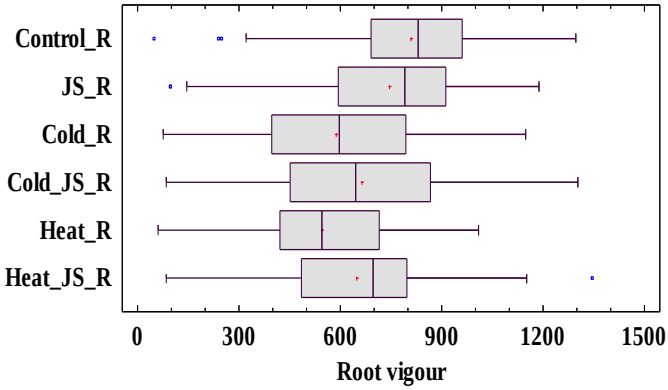


Figure.1. Root vigour of corn germinated from seeds exposed different treatments:
control – untreated; JS – treated with bioregulator; Cold – exposed to cold test; Cold_JS - exposed to cold test and treated with bioregulator; Heat - exposed to heating; Heat_JS - exposed to heating and treated with bioregulator.

Previously [10], different physiological responses of super sweet, semi-flint and popcorn seeds to heat and cold test were shown, specifying their different ability to adapt to stress conditions.

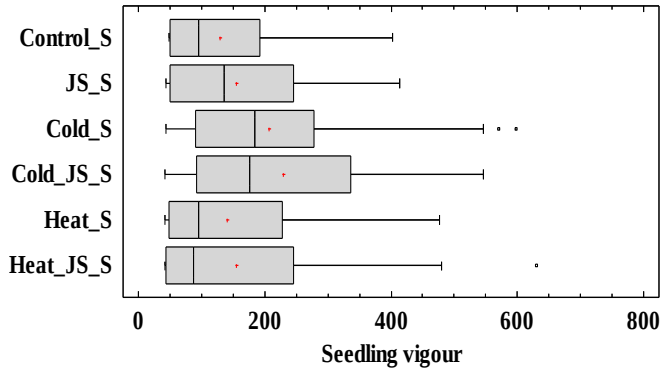


Figure.2. Seedlings vigour of corn germinated from seeds exposed different treatments:
control – untreated; JS – treated with bioregulator; Cold – exposed to cold test; Cold_JS - exposed to cold test and treated with bioregulator; Heat - exposed to heating; Heat_JS - exposed to heating and treated with bioregulator.

The evaluation of factor impact such as temperature and JS treatment of corn seed on root and seedling vigour of hybrid P455 was carried out by ANOVA analysis (Table). The temperature significantly ($p \leq 0.05$) influenced both root and seedling vigour more than the treatment with bioregulator. The interaction between temperature and bioregulator factors contributed to changes significantly ($p \leq 0.05$)

only in root vigour (Table 1). The contribution of temperature from total impact was 9.19% and 7.44%, respectively in root and seedling vigour changes.

Table 1. Factor impact on root and seedling vigour

Factor	Sum of squares	Df	Mean square	F-ratio	P-value
Root vigour					
Temperature (T)	3.339E6	2	1.669E6	23.58	0.0000*
Bioregulator (JS)	180517.0	1	180517.0	2.87	0.0906
Interactions T-JS	719026.0	2	359513.0	5.72	0.0035*
Total	3.6332E7	518			
Seedling vigour					
Temperature (T)	618890.0	2	309445.0	20.80	0.0000*
Bioregulator (JS)	56450.3	1	56450.3	3.79	0.0520
Interactions T-JS	3710.65	2	1855.32	0.12	0.8828
Total	8.3190E6	513			

Note: * - denotes the statistically significant difference at P≤0.05

CONCLUSIONS

Under the influence of non-optimal temperatures, the contribution of the JS natural bioregulator to increasing the vigour of the root system and seedling of the P455corn hybrid is significantly reduced.

Acknowledgments: This study was supported by the Ministry of Education and Research of the Republic of Moldova within the Subprogram 011101 "Genetic and biotechnological approaches to agro ecosystem management under climate change conditions" for 2024-2027.

REFERENCES

1. IVANOVA, R.; LUTCAN, E.; BOROVSKAIA, A.; VANICOVICI, N. Correlation analysis of corn bio-morphological traits in the initial growth phase under different temperature conditions. In: AGROSYM-2024. Proceedings of XV International Scientific Agriculture Symposium, [editor in chief Dusan Kovacevic]. East Sarajevo: Faculty of Agriculture, Bosnia and Herzegovina, 2024, p.254-259. ISBN 978-99976-816-8-3. https://agrosym.ues.rs.ba/archive.
2. SCALVI SOMMER, A.; MEDEIROS COELHO, C.M.; PADILHA, M.S. et al. Vigor of hybrid corn seeds is determinant for the establishment of seedlings in the field. In: Revista de Ciências Agroveterinárias, 2024, vol. 23, no. 1, pp. 62-69. ISSN 2238-1171. https://doi.org/10.5965/223811712312024062.
3. KHAEIM, H.; KENDE, Z.; JOLANKAI, M. et al. Impact of temperature and water on seed germination and seedling growth of maize (Zea mays L.). In: Agronomy, 2022, vol. 12, 397. ISSN: 2073-4395. https://doi.org/10.3390/agronomy12020397.
4. NEILL E.M., BYRD M.C.R., BILLMAN T. et al. Plant growth regulators interact with elevated temperature to alter heat stress signaling via the unfolded protein response in maize.

In: Science Reports, 2019, vol. 9, 10392. https://doi.org/10.1038/s41598-019-46839-9.

5. CAPO, L.; SOPEGNO, A.; REYNERI, A. et al. Agronomic strategies to enhance the early vigor and yield of maize part II: the role of seed applied biostimulant, hybrid, and starter fertilization on crop performance. In: Frontiers in Plant Science, 2023, vol. 14, 1240313. https://doi.org/10.3389/fpls.2023.1240313.
6. ELISOVETCAIA, D.; IVANOVA, R.; BRINDZA, J. Influence of Juniperus sabina, alginite and bioregulators on the germination kinetics of beech seeds of Roznava origin. In: AGROSYM-2024. Proceedings of XV International Scientific Agriculture Symposium, [editor in chief Dusan Kovacevic]. East Sarajevo: Faculty of Agriculture, Bosnia and Herzegovina, 2024, p. 1451-1456. ISBN 978-99976-816-8-3. https://agrosym.ues.rs.ba/archive.
7. ISTA. 2017 International rules for seed testing. Chapter 5: The germination test. 2017. https://doi.org/10.15258/istarules.2017.05.
8. GOGGI, A.S.; CURRY, D.; DANIELS J. Cold test and saturated cold test reliability for testing carryover corn seed treated with seed-applied insecticides. In: Seed technology, 2009, vol. 31, no. 1, pp. 7-20. ISSN: 1096-0724. https://stjournal.org/volume-31-no-1-2009/.
9. KHAN, S.; ULLAH, A.; ULLAH, S. et al. Quantifying temperature and osmotic stress impact on seed germination rate and seedling growth of Eruca sativa Mill. via hydrothermal time model. In: Life, 2022, vol. 12, 400. ISSN: 2075-1729. https://doi.org/10.3390/life1203040.
10. LUTCAN, E.; BOROVSKAIA, A.; IVANOVA, R. Germination of corn seeds under conditions of low and high temperature stress. In: Natural sciences in dialog of generations. The National conference with international participation, ed .7, 12-13 September 2024. Abstract book, Chisinau: Editura USM, 2024, p. 213. ISBN 978-9975-62-756-6. https://ibn.idsi.md/sites/default/files/imag_file/213_18.pdf.