

Research & Reviews: Journal of Botanical Sciences

PEG Treatment Improves Germination and Establishment in Older Seeds of Camelina (*Camelina sativa* (L.) Crantz): A Potential Biofuel Crop

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Short Communication

Received date: 21/12/2016
Accepted date: 07/05/2016
Published date: 09/05/2016

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Keywords: Seed viability, Germination, Osmotic treatment.

ABSTRACT

Loss of seed viability upon storage is a major concern for oilseed crops. Polyethylene glycol 6000 (PEG 6000) mediated osmotic and salt (NaCl) induced ionic treatments were given with an objective to enhance the seed germination and survival in a potential biofuel crop, Camelina (*Camelina sativa* (L.) Crantz). In a PEG treatment (10% w/v), opening of cotyledonary leaves as well as seedling survival was significantly higher than the control and other osmotic and/or ionic treatments. The plants germinated from seeds treated with PEG were viable and produced flowers and seeds. Thus, the finding revealed positive influence of PEG treatment on seed germination and vigor of seedlings obtained from Camelina seeds with reduced viability. The simple and efficient approach based on PEG induced osmotic treatment may be useful to enhance the germination and vigor of Camelina seedlings.

Camelina (*Camelina sativa* (L.) Crantz), also known as gold of pleasure or false flax, is a promising alternative energy crop from the Brassicaceae family. It is native to Northern Europe and Central Asia. Camelina has several beneficial agronomic characteristics such as a short growing season (90-110 days) and, it is tolerant to saline, cold, drought and semiarid environments. With high seed yield as well as non-edible oil content, Camelina can be efficiently processed into high quality renewable biofuel using existing technologies. Earlier life-cycle analysis of Camelina derived biofuels revealed significantly lower life cycle greenhouse gas emissions and cumulative energy demand than the corresponding petroleum derived fuels ^[1]. Further, the fuel properties of Camelina biodiesel compare favorably with their corresponding fossil-derived counterparts. Considering its potential to considerably enhance the domestic biofuel production, defence research and development organisation (DRDO), Ministry of Defence, Government of India introduced the crop through NBPGR, New Delhi ^[2]. Jatropha, another important biofuel plant, shed leaves during winter season and Camelina being short duration winter crop can be grown as an intercrop for continuous supply of feed stock for biofuel production.

Nucleus seed (the initial amount of pure seed) of the introduced cultivars has been multiplied and suitability trials in different agroclimatic zones during different seasons are completed ^[2]. However, one of the major constraints is loss of seed viability with storage as typically observed also in other oil seeds. One year old Camelina cv. Iwan (EC 643909) seeds when sown in field and Petri dishes under laboratory conditions, exhibited poor viability. Most of the seeds did not germinate and those germinated failed to survive post radical protrusion.

Seed treatments with osmotic and ionic solutions are known to enhance seed performance and tolerance of seedlings to subsequent stress exposures ^[3]. Therefore experiments were designed to test seed germination and survival after treatment with PEG and sodium chloride (NaCl 25, 50 mM) solutions in glass petri dishes.

Three days after sowing, the protrusion of the radicle was observed in control and other treatments. About 50% seeds exhibited radical protrusion in control and PEG treatments. However, post radical protrusion development in terms of opening of cotyledons inhibited in control, 1 and 5% PEG treatments (**Figures 1 and 2**) resulting to the significant reduction in survival of the seedlings at 15 days after sowing. In 10% PEG treatment, opening of cotyledons was significantly higher than 15% PEG

and other treatments (**Figure 2**). Survival of the seedlings was four fold higher in 10 and 15% PEG treatment than the control (**Figure 3**). On seed treatment with salt, radical protrusion (%) as well as opening of cotyledons was either similar or reduced than the control (**Figure 2**). However, survival of the seedlings in the salt treatment was two-three folds higher than the control. Thus, PEG treatment had a significant effect on germination and seedling establishment in the introduced seed lot with lower seed viability. The PEG treatment benefits in reducing the oxidative damage to membrane system in the process of seed imbibition and repair the membrane injury by controlled hydration ^[4,5]. Further, completion of pre-germinative metabolic activities and metabolic repair processes, resulting the earlier and higher seed germination than untreated seeds, may be the reason for early and high emergence of the PEG primed seeds ^[6]. Further, PEG being an osmotic agent plays an important role in regulating cellular metabolism leading to enhanced germination and higher vigor in the treated seeds ^[7]. The surviving seedlings from the PEG and salt treatment were transplanted to pots filled with potting mixture (soil: sand: FYM-Farm Yard Manure; 1:1:1) for further seed multiplication. However, the seedlings did not survive post transplanting. Therefore, seeds were sown in pots filled with potting mixture and PEG 6000 solution (10%) was applied once to the pot after sowing. Thereafter the pots were watered regularly as per the requirement. Seeds germinated successfully with healthy growth and seed setting to successfully multiply the initially received introduced seeds.

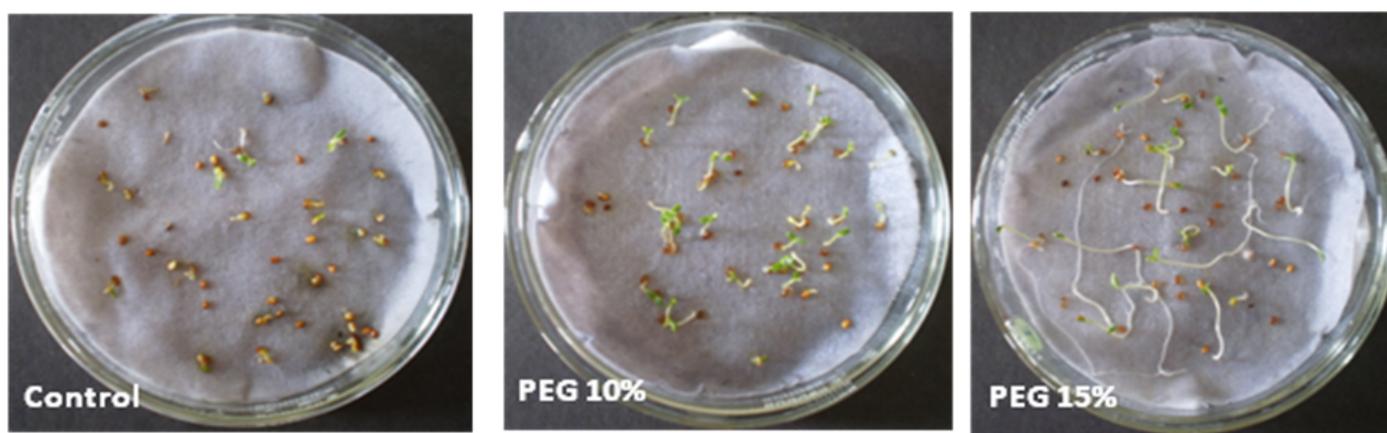


Figure 1. Effect of PEG treatments on seed germination in Camelina.

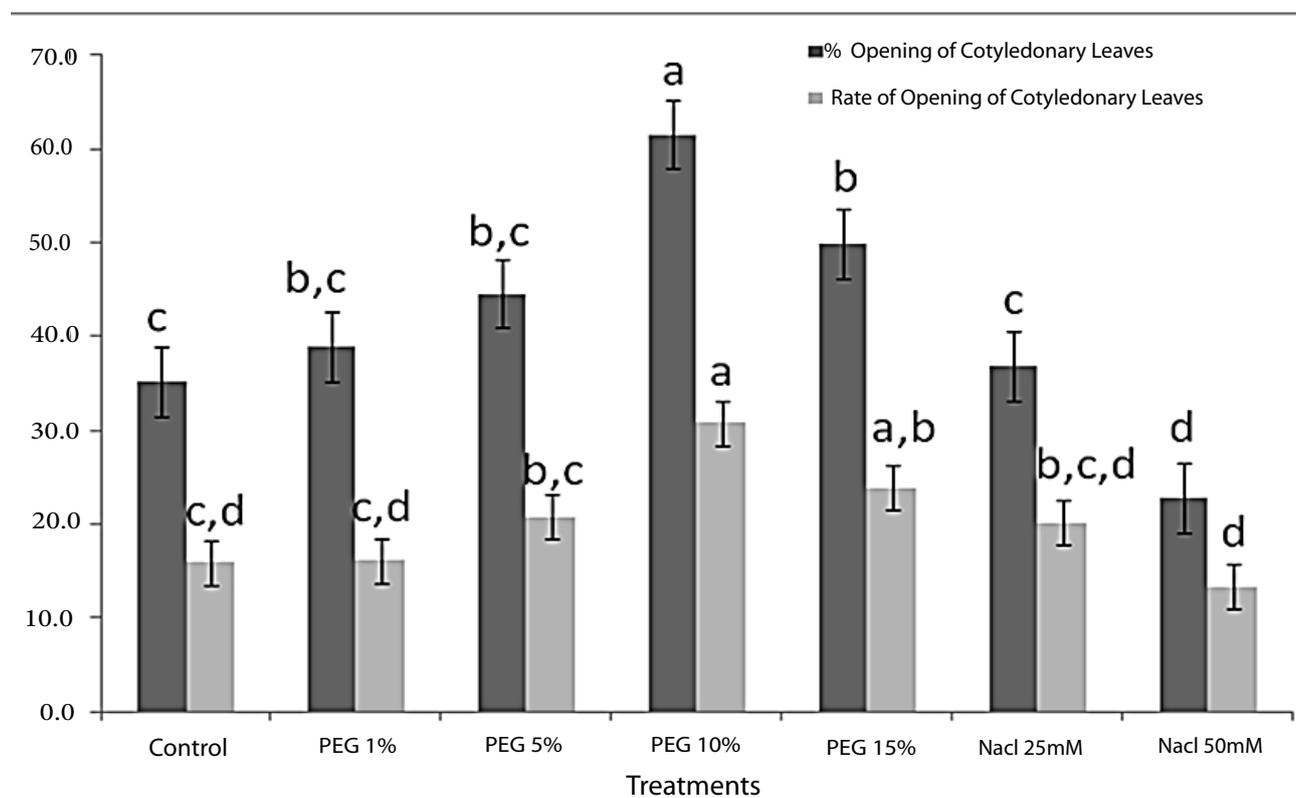


Figure 2. Effect of PEG and salt (NaCl) treatments on opening of cotyledonary leaves in Camelina. Error bars indicate SE (M). Means (n=4) indicated by different letters in one series are significantly ($P \leq 0.05$) different according to LSD test.

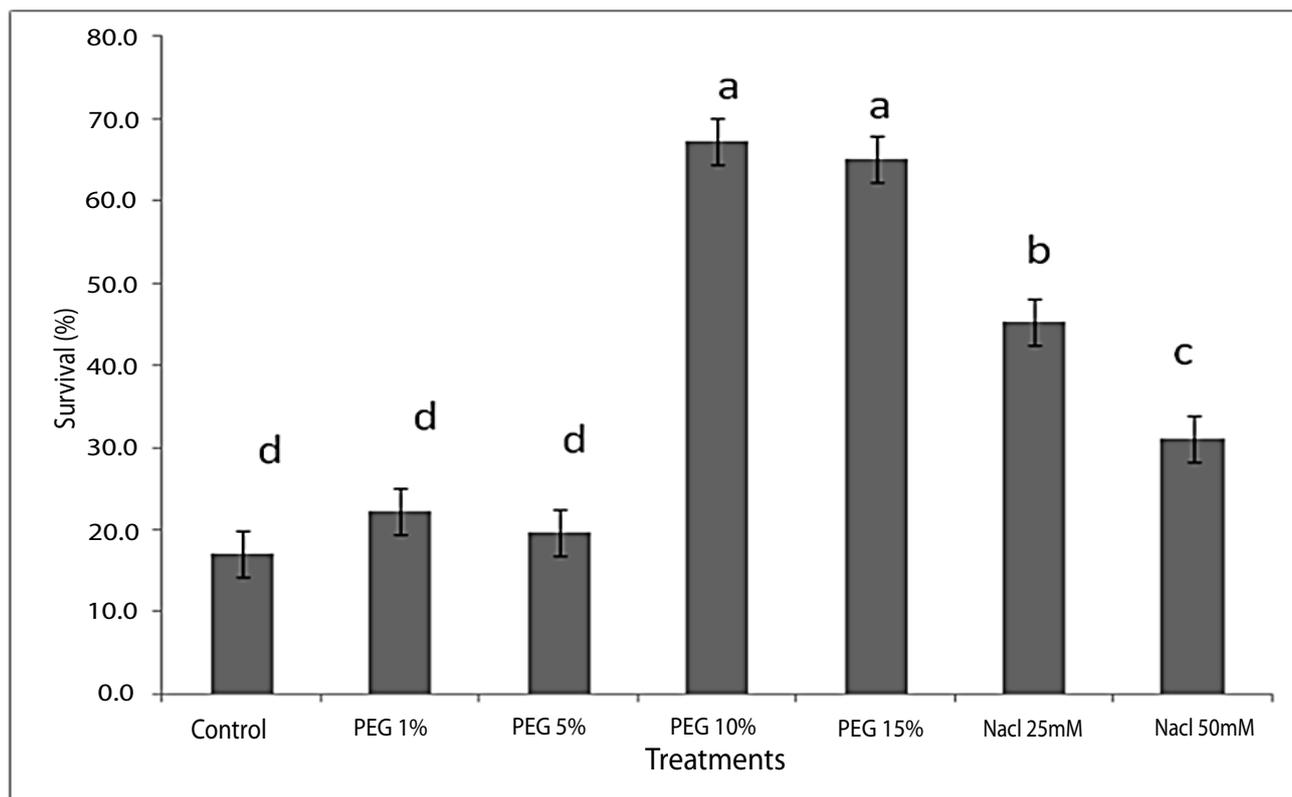


Figure 3. Effect of PEG and salt (NaCl) treatments on survival of *Camelina* seedlings recorded 15 days after sowing. Bars indicate mean (n=4) survival. Error bars indicate SE (M). The mean survival indicated by different letters are significantly ($P \leq 0.05$) different according to LSD test.

In conclusion, this experiment revealed positive influence of treatment with PEG on germination of seeds and vigor of seedlings obtained from batches of *Camelina* seeds that showed reduced viability.

ACKNOWLEDGMENTS

Authors are grateful to Dr. J. Vollmann, BOKU-University of Natural Resources and Applied Life Sciences, Vienna, Austria for providing the nucleus seed of *Camelina* cv. Calena and, Director of NBPGR, New Delhi for cooperation and support during introduction of *Camelina* seed from Austria. Research Fellowship to Deepti Khatri and Kamal Kumar from DRDO, Ministry of Defence, Government of India is gratefully acknowledged.

REFERENCES

- Shonnard DR, et al. *Camelina*-Derived Jet Fuel and Diesel: Sustainable Advanced Biofuels. *Environ Prog Sustainable Energy*. 2010;29:382-392.
- Agarwal A, et al. *Camelina sativa*: A new crop with biofuel potential introduced in India. *Curr Sci*. 2010;99:1194-1195.
- Patade VY, et al. Chemical seed priming as an efficient approach for developing cold tolerance in *Jatropha*. *J Crop Improv*. 2012;26:140-149.
- Ma HY and Liang ZW. Research progress on improving germination rate of *Leymus chinensis*. *Grassland of China*. 2005;27:64-68.
- Goswami A, et al. Drought resistance in rice seedlings conferred by seed priming : role of the anti-oxidant defense mechanisms. *Protoplasma*. 2013;250:1115-1129.
- Mc Donald MB. Seed priming. In: Black M, Bewley JD (Eds). *Seed technology and its biological basis*. Sheffield Academic Press, Sheffield, UK. 2000;287-325.
- Farashah HD, et al. Germination improvement and (alpha)-amylase and (Beta)-1, 3-glucanase activity in dormant and non-dormant seeds of *Oregano* (*Origanum vulgare*). *Austr J Crop Sci*. 2011;5:421-427.