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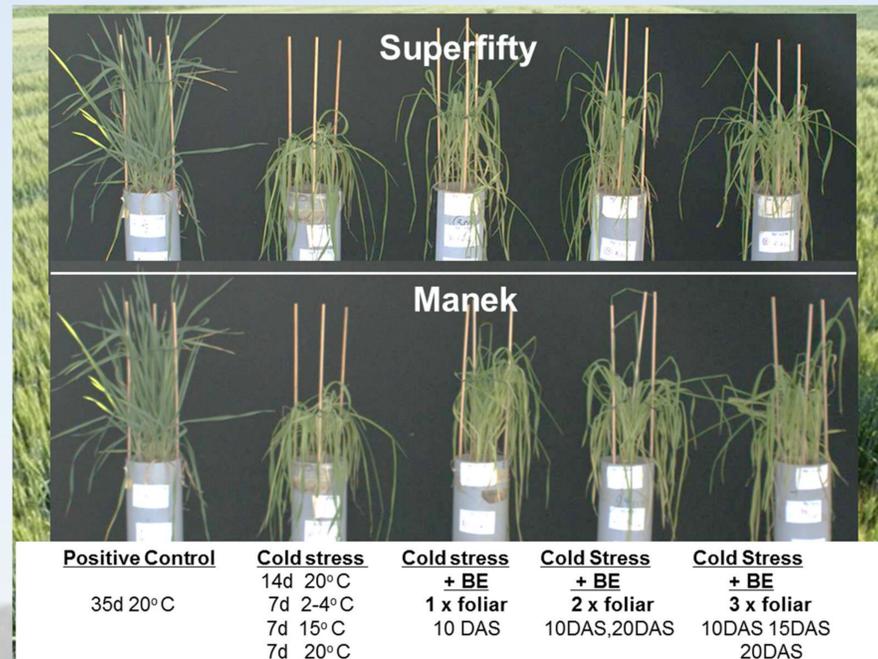
Aim of the studies

Intense expression of winter hardiness in winter cereals is not regularly required, and is frequently not adequately considered during selection of cultivars. However, under unfavorable conditions extreme yield losses have been reported. Therefore, this study investigated the protective potential of BE products based on micronutrients (Zn, Mn, Si) plant-, and seaweed extracts, showing beneficial effects in earlier field trials conducted in Northern Ireland (AFBI).

Bio-effector preparations tested in the field experiment

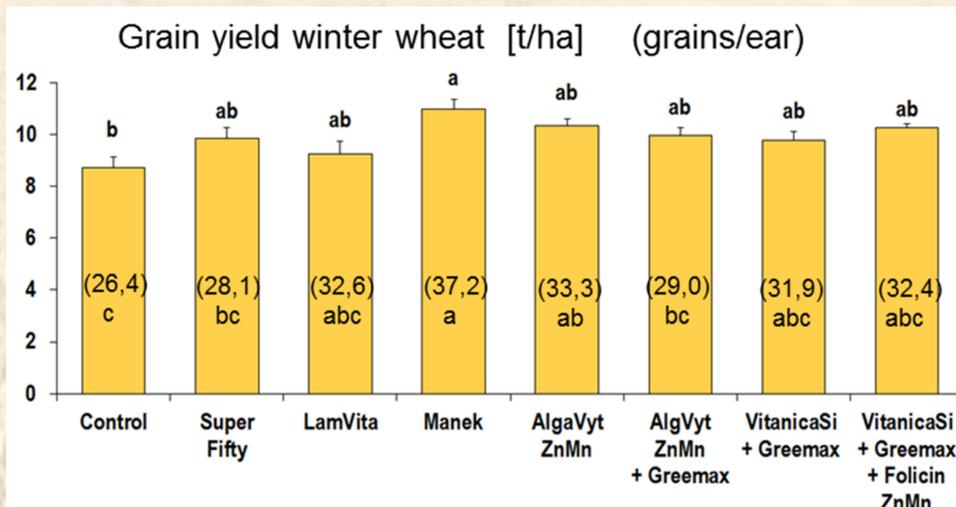
Product name	Bio-Effector	Producer	Description
Super Fifty 3 l ha ⁻¹	Seaweed extract	BioAtlantis Ireland	highly concentrated alkaline extract from <i>Ascophyllum nodosum</i>
LamVita 2 l ha ⁻¹	Seaweed extract	BioAtlantis Ireland	<i>Laminaria</i> extract
AgaVyt Zn/Mn 500 g ha ⁻¹	Seaweed extract	Agriges Italy	<i>Ascophyllum nodosum</i> , <i>Fucus</i> spp, <i>Laminaria</i> spp., <i>Spirulina</i> spp, enriched with 5.1 % urea, 6.1 % Zn and 5.6 % Mn (w/w)
Manek 625 ml ha ⁻¹	Plant extract Vegetable oils and rare medicinal herbs	Agriges Italy	rich in fatty acids, alkaloids, diterpenes, glucosinolates, phenols, sesquiterpenes, tannins, etc.
Vitanica Si 16 l ha ⁻¹	Organic NPK, Si & seaweed <i>Ecklonia maxima</i>	COMPO Germany	5 % N as urea (carbamid), 3 % P ₂ O ₅ (1.31 % P), 7 % K ₂ O (5.81 % K), 1.7 % Na, 10 % SiO ₃ (3.69 % Si)
Folicin Zn 0.5 l ha ⁻¹	zinc chelate	Jost Germany	91 g Zn liter ⁻¹
Folicin Mn 1.5 l ha ⁻¹	manganese chelate	Jost Germany	80 g Mn liter ⁻¹
Greemax 100 ml ha ⁻¹	Based on polymers of polyethylene and polypropylene glycol mixed with aliphatic alcohols and organic oils	Stallen, Switzerland	surfactant for pesticides and foliar fertilizer applications

Lab experiments



In a pot experiment with winter wheat, exposed to 14 d cold stress treatments, one foliar application of the seaweed extract "Superfifty" or the plant extract "Manek" prior to the onset of the stress treatment was sufficient for induction of protective effects. Priming Effect! (physiological analysis is on the way)

Field Data



Grain yield was significantly increased by Manek (26%) but a trend between 6% - 18 % yield increase was recorded also for the remaining treatments. This was associated with an increase in grain number per ear by 41 % for Manek and 26 % for Algavyt Zn/Mn.

Conclusions

- Increased winter hardiness of winter wheat by foliar autumn and spring applications of micronutrients plant and seaweed extracts (particularly effective: **Manek Plant Extract**. (Results 2016 Horb Germany)
- Lab experiments suggest a priming effect of stress adaptations, which would enable a reduced number of applications. (economy)
- Positive yield effects in 3 field trials (Ireland/Germany) Average grain yield: +16 %; Current economic benefit: 45 - 252 €/ha.

Experimental Setup:

No P fertilizer, N fertilization in 3 rates, total N supply 200 kg ha⁻¹, randomized block design, n = 5; plot size: 6.25 m x 5 m = 31.25 m², Sowing distance 15 cm



Application of bio-effectors by foliar sprayers (five times application except Si with four times application) during (A) 4 leaves stage in November 2015, (B) vegetation start in March 2016; 14 days later, 28 days later, and finally 5th application at flag leaf stage (C) Harvesting in July 2016 by cutting three representative parts of each plot (D) wheat grains of harvest.