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RESEARCH NEWSLETTER

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Boron Deficiency in Tulip
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Boron deficiency in tulip is an occasional problem, but when it occurs it causes substantial economic damage to forced cut flowers or pot plants. It can apparently occur in bulbs grown in The Netherlands or from Southern hemisphere production, including Chile.

Role of boron and deficiency symptoms in higher plants

Boron is a micronutrient required by all higher plants. It has a role in cell division and cell wall formation and integrity. Boron deficiency causes symptoms that result from plant cells that are not properly "stuck together". In higher plants, boron deficiency causes a number of symptoms. Cracks often appear in stems. These cracks are horizontal, and show across the width of the stem. The basal part of young leaves and internal tissues of organs may become necrotic. One of the earliest symptoms is failure of the root tips to elongate normally. Terminal shoot meristems also die giving rise to a witch's broom. Young leaves become very thick, leathery, and chlorotic; in some species young leaves may be crinkled because of necrotic spots on leaf edge during development. Young leaves of terminal buds become light green then necrotic and stem finally dies back at terminal bud. Rust colored cracks and corking occur on young stems, petioles, and flower stalks. Common physiological problems associated with boron deficiency in crop plants includes "Heart rot" of beets and "stem crack" of celery.

Boron deficiency in tulip

In late 2007, we were presented with fresh cut tulips, grown on the US west coast that had a suspected boron deficiency. The bulbs had been grown in the southern hemisphere (Chile). After one day in the vase, stems were very brittle, with the stems snapping 3-8 cm below the bud. If gently bent, the stems would suddenly snap in two, or, in some cases, small cracks across the stem could be seen; if additional pressure was applied, the stem would then snap cleanly in two. It's worth noting that this is a very different problem than "stem topple", which is a calcium deficiency. In that case, tulip stems will fall over during or after forcing. A main difference is that with calcium topple, the stem collapses and constricts, rather than sharply breaking in two.

Cracking and horizontal peeling of the epidermis ("skin") of the flower petals was also observed in our tulips. These cracks were on the inside and outside of the petals. In older flowers (harvested 2 weeks earlier, and held in a cooler), the base of the petal actually expanded like a balloon. In these petals, one could pull the outer and inner epidermis apart, revealing a mass of yellow, disorganized internal tissues of the petal. This tissue looked like a thick net or web of yellowish fibers that had no structure or organization at all.

How does boron deficiency develop in tulip?

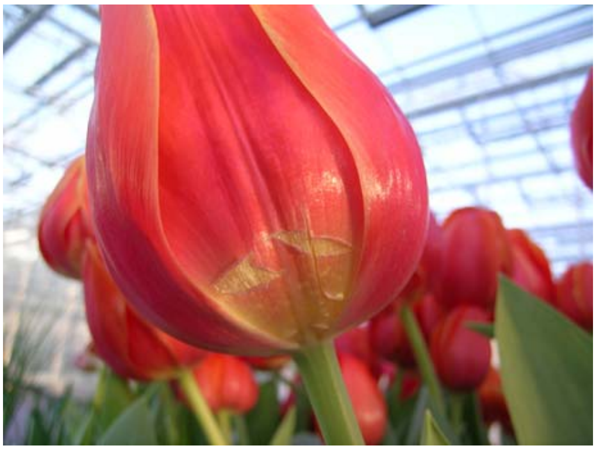
Boron deficiency starts during the bulb production phase. When tulips are grown on boron deficient soils, the bulbs cannot absorb enough boron from the soil, and an eventual shortage develops in the tissue. The flowers we saw had grown from bulbs produced in Chile. According to a lengthy article by Shorrocks (1997), many soils in Chile are known to be boron deficient. Many factors are involved in boron deficiency including high light levels, dry soils, warm, dry air, liming, and a general low level

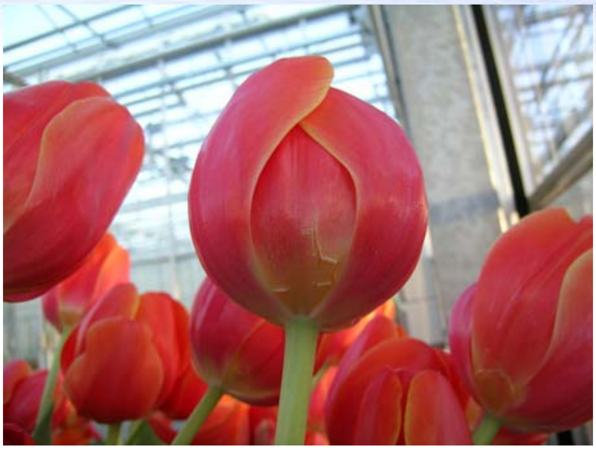
of soil boron. Certainly, sandy soils with low levels of organic matter, as can happen in Holland can also be susceptible to boron deficiencies.
Application of boron in the range of 1-2 kg boron/ha (about 1-2 lb boron/acre) is usually adequate for correcting field soils. This is a very small amount of material, and should be applied in consultation with a local soils and nutrition expert. According to the Dutch "Sick Book", certain cultivars are known to be boron sensitive, including 'Abra', 'Ad Rem', 'Blenda', Don Quichotte', 'Kingsblood' and 'Lustige Witwe'.

Correcting boron deficiency during forcing

One of the problems with studying a problem such as this is reliably obtaining bulbs that are known to be boron deficient…regardless of the source of production. If such bulbs could be obtained then research into boron fertilization during forcing could be conducted.

I do not know if addition of boron during tulip forcing would correct boron deficiency in tulip. The problem is the rapid growth rate of the crop, and whether or not boron applied during forcing would be "early enough" to exert the effect of binding cell walls together to prevent collapse of the internal structure of the petal or stem. Regardless, there should be little, if any danger from boron application during forcing…assuming correct rates are used. Given the many possible boron sources, it is impossible to list all rates here, but they can be obtained by reading information on a bag of, for example, Solubor. Peat-lite type fertilizers also contain boron, and could probably be used successfully. Over application, of course, could lead to boron toxicity, which it a totally different problem.





Images of presumed boron-deficient flowers from a mid-January flowering in the Netherlands. Images 8158, 8159, 8161.

Hydro-forced 'Uncle Tom' showing typical the sharp, horizontal stem crack typical of boron deficiency. Image from a commercial crop in the Netherlands. Image 0808.

Update on 1-MCP (EthylBloc, SmartFresh, FreshStart, EB-01)

By Bill Miller
Cornell University

There are new and exciting developments concerning the anti-ethylene gas, 1-MCP. Many readers will know that much work has been done on this material at PPO Lisse and at Cornell. 1-MCP is effective in reducing ethylene injury in tulips and the earlier research has demonstrated the effectiveness of this product in reducing ethylene injury in tulips. While legal to use in The Netherlands, the owner of the product unfortunately has not made it available to the bulb industry.

This is hopefully going to change! In early 2007, Floralife (a US postharvest company) was acquired by Smithers-Oasis (a worldwide manufacturer of floral foams). Part of the deal was the acquisition of worldwide floriculture rights for 1-MCP minus Africa (the rights to which were originally held by Floralife), including applications in bulb storages in the Netherlands. The technology and ownership of 1-MCP still resides with Rhom and Haas and its subsidiary, AgroFresh. While details need to be worked out, it is expected that 1-MCP will be available within The Netherlands in the relatively near future. At this moment, 1-MCP is legally available for use in US-based tulip storages.

This is indeed good news for the bulb industry since *Fusarium* and ethylene continue to plague the industry. It is important to realize that 1-MCP only *reduces the effects* of the ethylene. It does not kill *Fusarium*, it does not reduce *Fusarium* infection, nor does it "cure" *Fusarium* infected bulbs. It only reduces ethylene injury on otherwise non-infected bulbs. In no way will 1-MCP solve the ongoing *Fusarium* challenges in the industry, but it will prove useful in maintaining higher quality bulbs in storage.

The 1-MCP (EthylBloc) product comes as a white powder, which when dissolved in water, releases 1-MCP as a colorless, odorless gas. The 1-MCP gas permeates the bulb and binds to the molecular receptors for ethylene. With the ethylene receptors blocked, atmospheric ethylene can no longer injure the bulb. A given 1-MCP treatment remains effective for 12-14 days to 3+ weeks, depending on the time of application in the season, temperature, cultivar, etc. Presently, there are two main forms of EthylBloc available to the US industry (in the US): "truck kits" that are used to treat 20 to 40-foot truck trailers, or "sachets", which are small packets of 1-MCP that are activated by water, then placed into boxes containing cut flowers.
For more information, see the Floralife website at http://www.floralife.com

Topflor Dips for Hyacinth Height Control

By Bill Miller
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Height control, especially in the postharvest phase, remains a potential problem in hyacinth. During forcing, hyacinths are commonly sprayed with Florel for height control, and to reduce stem floppiness. Rates are commonly in the range of 1,000-2000 ppm, for 1 or 2 sprays. While generally effective, some growers report problems with Florel sprays, including lack of effect and non-uniformity.

Starting in 2001-2002 we began a program evaluating alternative methods of height control for hyacinth, including trials with plant growth regulator (PGR) sprays, soil drenches and pre-plat bulb dips. We initially focused on Sumagic (uniconazole) and Bonzi/Piccolo (paclobutrazol) as the main PGRs, but more recently added Topflor (flurprimidol). This product has been used in Europe for many years as a general floriculture PGR, and it has turned out to be an excellent product for use on hyacinths.

To give just one example of this, see the photos of Aiolus from our 2007 research. The photos show Aiolus dipped in 20 ppm Topflor for 0 (untreated controls), 10, 30, 60, or 120 minutes. After dipping, bulbs were planted and cooled. The first set is bulbs cooled for 15 weeks (housed on 30 Jan); the second set had longer cooling (19.5 weeks) and was housed

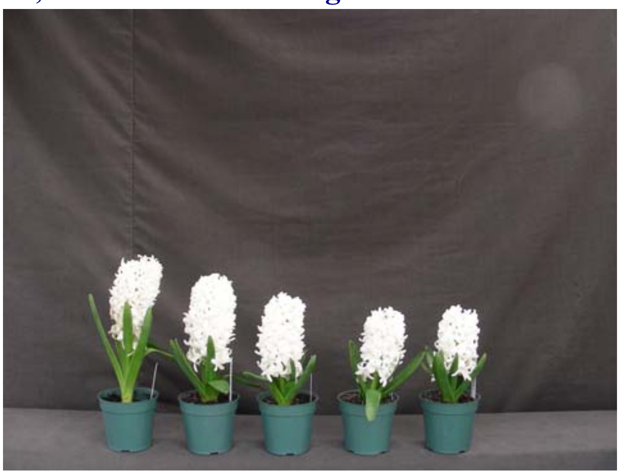
5 March. The two photos per set show early in the flowering phase and the second shows longer term effects.

Conclusion

Given the costs of commercial products and the necessary concentrations for effectiveness, it is likely that Topflor is the most cost effective of PGRs to use on hyacinths. A starting point for commercial trials would be to dip hyacinth bulbs into 20 ppm Topflor for 10 minutes. This concentration works well across a number of cultivars and cooling durations, and should give good results in most cases. A slight (1-2 day) flowering delay might be observed, along with shorter stems and leaves. For very late forcing (long cold durations), a longer dip (30 minutes) would be suggested.

Aiolus (Cooled 15 weeks, housed 30 January)

Left to right: Control, 20 ppm Topflor for 10, 30, 60, or 120 minutes. Image 0109.



Postharvest.Left to right: Control, 20 ppm Topflor for 10, 30, 60, or 120 minutes. Image 0197.

Aiolus (Cooled 19.5 weeks, housed 5 March)

Left to right: Control, 20 ppm Topflor for 10, 30, 60, or 120 minutes. Image 0298.

Postharvest. Left to right: Control, 20 ppm Topflor for 10, 30, 60, or 120 minutes. Image 0384.

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