Drought and climate adaptation program

Yield, sustainability and profits of the Queensland capsicum industry are all reduced by extreme maximum temperatures

We documented the commercial impacts of extreme heat in a Lockyer Valley field grown capsicum crop in the summer of 2018-19.

Executive summary

Field grown capsicum (Capsicum annum) is a high value horticultural crop. In Australia field grown production is concentrated in Queensland, accounting for around 80% of national production according to publicly available statistics. The ABS Survey 2009 (Australian Bureau of Statistics), shows around 38,913 t of capsicums and chilli worth $91.98 million were grown in Queensland on about 1722 ha of land. Capsicums and chilli are grown year-round in Queensland with production centered in the Bowen, Giru, and the Bundaberg regions in the winter and the Lockyer Valley and Granite Belt regions in the summer.

Fruit sunburn accounts for around 25% of marketable yield loss in summer harvested crops - when consumer demand and market price is at its highest. This commercial observation trial investigated whether relatively cheap protective net could be adopted by growers to mitigate the effects of high summer temperatures, reduce fruit sunburn and markedly improve the viability of summer capsicum production in the Lockyer Valley and other high temperature growing locations. This commercial observation trial quantifies and documents the marketable yield loss caused by sunburn due to the extreme temperatures in the summer of 2018-19 in the Lockyer Valley.

This observational project was supported by the Use of Bureau of Meteorology multi-week and seasonal forecasts to facilitate improved management decisions in Queensland's vegetable industry project.

This project is part of the Queensland Government's Drought and Climate Adaptation Program that helps producers to better manage drought and climate impacts through improved forecasts products, tools and extension activities.

The experimental forecast project work focussed on developing and testing multi-week and seasonal forecasts for the vegetable industry in the Granite Belt and Lockyer Valley horticultural production regions of Queensland, with an emphasis on Maximum Temperature.

Capsicum production in Queensland

Queensland produces 80% of the Australia's capsicum and chilli crop. In 2019-20 the gross value of Capsicum and Chilli production to the Queensland economy was forecast to be $168 Million (Queensland AgTrends 2019-20).

Capsicum, a warm season crop has traditionally been grown in the Lockyer Valley vegetable production region as a summer and autumn harvested crop. Capsicum prices are usually higher in the summer as there is more demand, but growing conditions are more difficult in the summer heat than they are in the autumn when daily maximum temperatures are cooler. The autumn crop, planted in late February or early March is harvested in late April or May and suffers much less sunburn as maximum temperatures are declining as the fruit matures however but both demand and market prices are generally lower.

Queensland Government

The number of commercial capsicum growers operating in the Locker Valley has declined markedly over the last 10 years. There are a number of reasons for this decline, but one major driver has been the impact of increasing summer maximum temperatures on fruit quality and marketable yield (Carey 2016).

Capsicum fruit sunburn damage in the Lockyer Valley summer cropping season is responsible for around 25% of marketable yield loss, according to local growers and as a result Lockyer Valley capsicum growers rely on above average market prices through the summer to offset this impact (B. Fisher 2014, pers. comm., Nov 2014).

Loss of marketable fruit due to sunburn is not confined to the Lockyer Valley, growers in all Queensland production regions (Granite Belt, Lockyer Valley, Bowen and Bundaberg), interstate and overseas report that sunburn damage accounts for a large percentage of their marketable yield loss (Ngouajio 2011; Goldwater, Ekman & Rogers 2018).

Figure 1. Sunburn damage on fruit as a result of extreme summer heat

Ideal growing conditions

Optimum temperatures for good capsicum fruit development are night temperatures of 15–17°C and day temperatures of 24–30°C. The fruit may be sun-scorched (sunburnt) during hot weather and fruit will show poor setting and poor colouring when temperatures are above 33°C.

(Web reference; https://www.agric.wa.gov.au/capsicums-and-chillies/growing-capsicums-and-chillies)

Documented commercial yield impacts

In the 2018 – 2019 summer growing season we worked with a commercial Lockyer Valley capsicum grower on his farm to document the impact of extreme heat events on summer harvested capsicum yield. Several hectares of capsicums were planted in late August and harvested in December. Part of one planting (23m X 9m of rows, or approximately 1015 plants) was covered with protective net just prior to fruit development. This part of the crop was managed in exactly the same way as the rest of the crop area throughout the cropping period. White hail netting (https://www.netprocanopies.com/index.php/crop-protection-canopy/) was installed above a random section of a commercially grown summer capsicum crop in Gatton in the 2018 summer growing season.

Figure 2 & 3. Capsicum crop, with low cost experimental protective net area visible.

In the photos above you can see that part of nine planted capsicum beds was covered, this allowed a direct comparison between covered and uncovered capsicum plants of the same variety, grown with the same management techniques and inputs.

The block of capsicums that contained the trial area covered with protective net was picked commercially in December 2018. The pickers kept track of where fruit came from within the block each time it was harvested and this yield information was recorded in the packing shed.

The commercial yield data below documents the number of kilograms of marketable fruit picked from outside the protective net and from under the protective net.

Once the half hectare block had been fully harvested the grower was able to compare the yield of marketable capsicum from the area under the protective net to the adjacent area of the same crop outside the net. The only difference between the two areas was the impact of the protective net, modifying the growing environment around the “protected” capsicum plants.

Marketable yield comparison

Table 1. Actual marketable yield in the unprotected and protected area of the crop.

Marketable yield of capsicum fruit in the unprotected part of the summer 2018 crop. **Unprotected**		Marketable yield of capsicum fruit in the protected part of the summer 2018 crop. **Protected**
Average marketable yield per plant	1.03 Kg	1.40 Kg
Marketed yield from 1015 plants, packed as 8 Kg cartons of fruit.	130 cartons Fruit sale value **$2400**	178 cartons Fruit sale value **$3560**
Potential fruit yield based on actual commercial yield data, but scaled to 71000 plants in the complete block.	9,093 cartons	12,451 cartons
Net return after marketing costs based on actual fruit sale price in December 2018 ($20 a carton).	$181,860	$249,020
Projected extra cash flow had the entire crop been grown under protective net structure.		$67,160
Projected return on investment had the whole planting been under a commercial protective netting structure (0.5 ha). Allowing **$50 000** to set up protective net. (Contractor, time and materials for install)		Based on this commercial yield comparison data, a full half hectare of protective net would have paid for itself in the first summer and delivered a bonus **34% return on investment** ($50K)) in that crop. A full half hectare protective net would have returned an extra $1.34 for each $1 spent on the protective canopy installation - in the first year!

Temperature measurements

Data loggers were installed in the crop prior to fruit development, both under the protective net and in the crop outside the protective net. This allowed a direct comparison to be made of daily maximum temperatures in December in the open crop area and under the protective net.

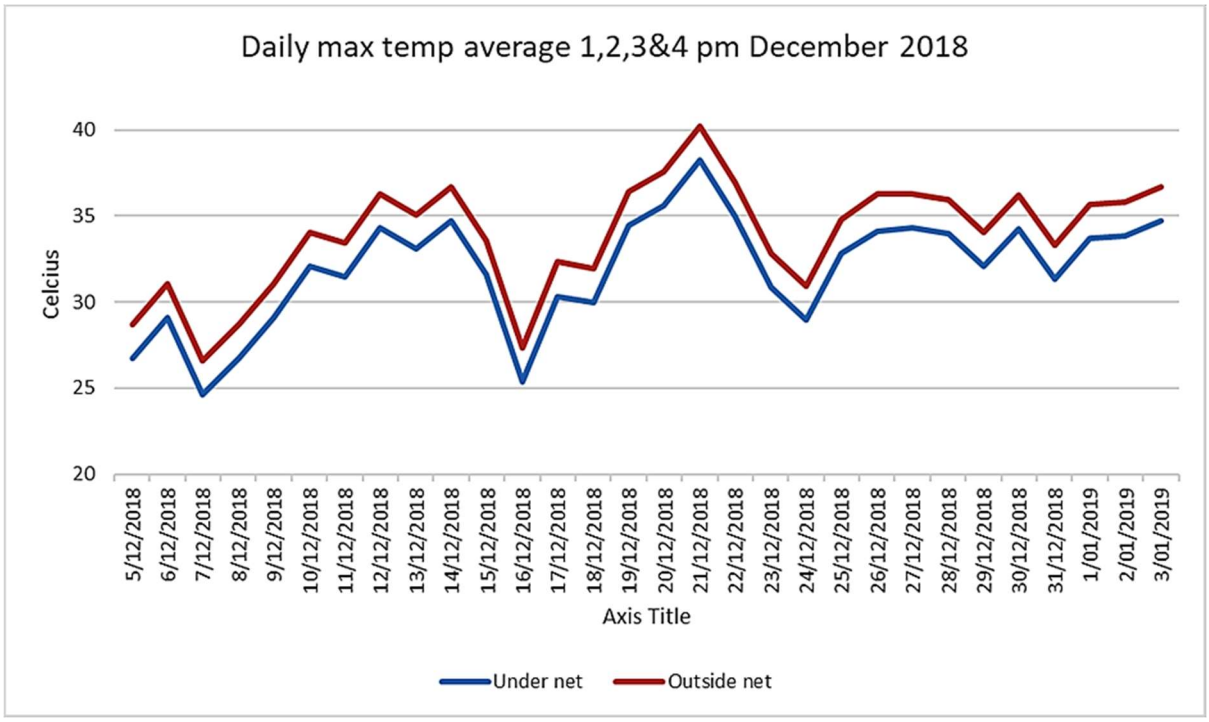

Figure 4. Average temperature between 1 and 4 PM inclusive each day under the protective net and outside protective net compared

Table 2. Measured average daily temperature between 1pm and 4 pm from the 5th Dec 2018 until the 19th of February 2020.

Climate Variable	Unprotected	Protected
Average daily air temperature 1-4pm	34.1°C	32.2°C
Comment	Daily maximum temperatures were on average 1.9°C cooler under the protective net throughout the hottest part of the day.	

Increased yield and fruit quality

The local grower who carried out this commercial observation trial was pleasantly surprised and handsomely rewarded for the effort of erecting the protective net over a 198 M^2 section of a commercial capsicum planting.

Actual marketed fruit yield and sales were improved by 36% in this on-farm commercial trial. The protective net reduced in crop maximum temperatures by around 2^oC in the hottest part of the afternoon (1 – 4 pm inclusive) in the extreme summer heat of the Lockyer Valley.

In addition to improved crop yield, picking efficiency was also improved saving additional labour costs. Pickers did not have to pick, sort and discard sunburnt fruit while harvesting and the fruit ran through packing line and size grader more easily with reduced waste. These picking and grading efficiencies were not documented in this exercise, but with permanent skilled labour costing about $32.00 an hour, these additional savings were also a significant benefit to the farms bottom line.

The bottom line

The protective net reduced average maximum daily temperatures under the net between 1 and 4pm each day by 1.9^oC during the fruiting and harvesting period of this summer capsicum crop. A comparison of marketable fruit yield from the usual open field and covered crop reveals the true cost of the extreme heat experienced by one grower in the 2018-19 summer season. The extreme heat reduced measured marketable fruit yield by 34%.

Marketable fruit yield increased by $1160.00 per unit area in the covered section of the crop when compared to the uncovered area. This equates to $1.14 in extra fruit sales income from every covered plant! Improved picking efficiency and improved packing efficiency both deliver additional labour cost savings, while enhanced fruit quality opens the door to premium fruit pricing.

This detailed on-farm work illustrates the real “hidden cost” for just one crop (field grown capsicum) of the extreme summer heat events that now occur regularly in Queensland’s Lockyer Valley!

Figure 5. Quality fruit grown under protective net

Figure 6. Data logger installation

Could the business manager have made a better decision using information and guidance from the Drought and Climate Adaptation Program’s long lead-time experimental forecast for the Lockyer Valley region?

The July 2018 long lead-time experimental forecast indicated that maximum temperatures for June, July, August and September 2018 be above the long-term mean.

The September 2018 long lead-time experimental forecast indicated that maximum temperatures for September, October, November and December would be above the long-

term mean. The forecast also indicated that minimum temperatures for those months would also be above the long-term mean.

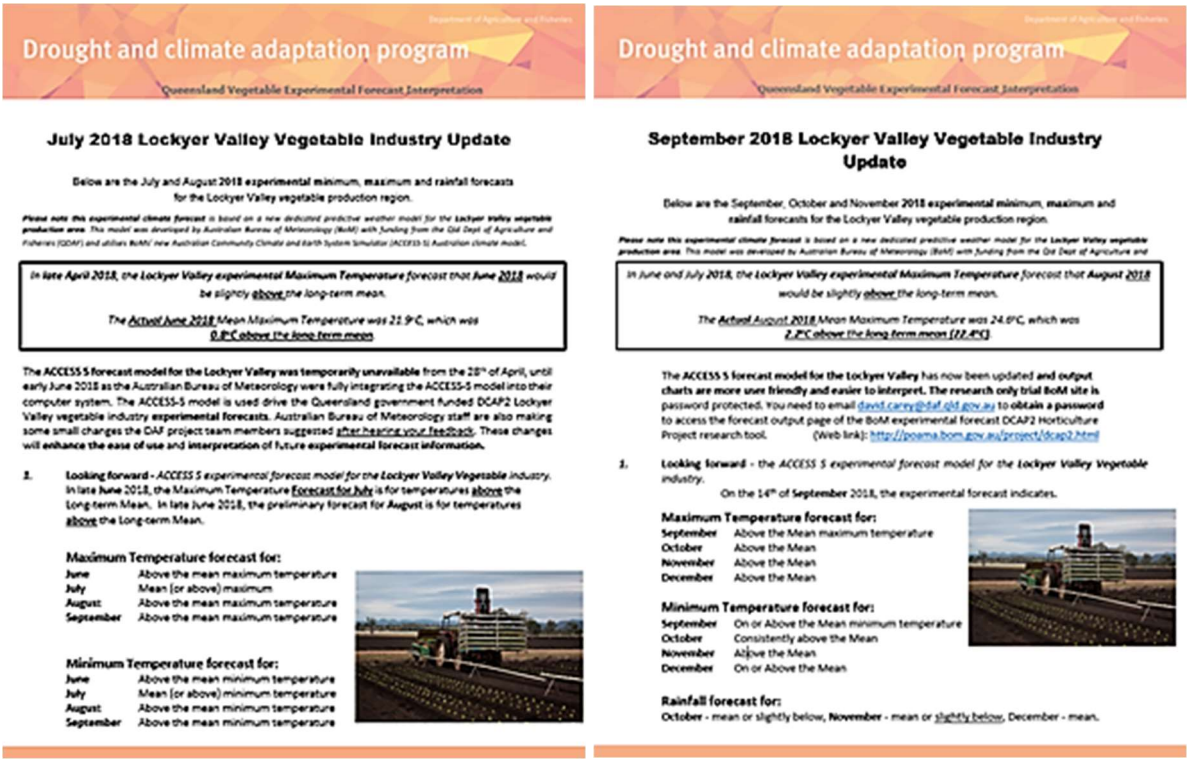

Figure 7. July and September 2018 experimental forecast for the Lockyer Valley vegetable production region.

The experimental forecasts indicated that mean maximum monthly temperatures during the growing and harvesting period of this 2018 Lockyer Valley capsicum crop would be above the long term mean during the fruiting and harvesting period.

The business manager chose to grow the crop as summer capsicum production is a key income stream for the business. The small “net protected” observation trial area was set up to observe its effect on fruit sunburn, to monitor how practical it was and compare marketable yield (see Table 1).

The business manager was confronted by the cost impact of the extreme maximum temperatures. He was surprised by the yield and quality difference he observed and measured when comparing yield from the small area of protective net. He is currently “considering options” for summer capsicum cropping and has sought quotes detailing the costs to “net” a 1 hectare block.

The business manager grows both winter and summer vegetable crops and is a collaborator in our DCAP Lockyer Valley long lead time experimental forecast work. He is very interested in a more accurate long lead time forecast as it helps him plan his production and informs his management decisions.

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