What makes a bad Qfly year?

The 2020/21 fruit production season is shaping up as a “bad year” for fruit fly throughout Australia, and particularly in Victoria. But why is this season worse than the last, how can we predict the type of season we can expect, and what can we do with this information?

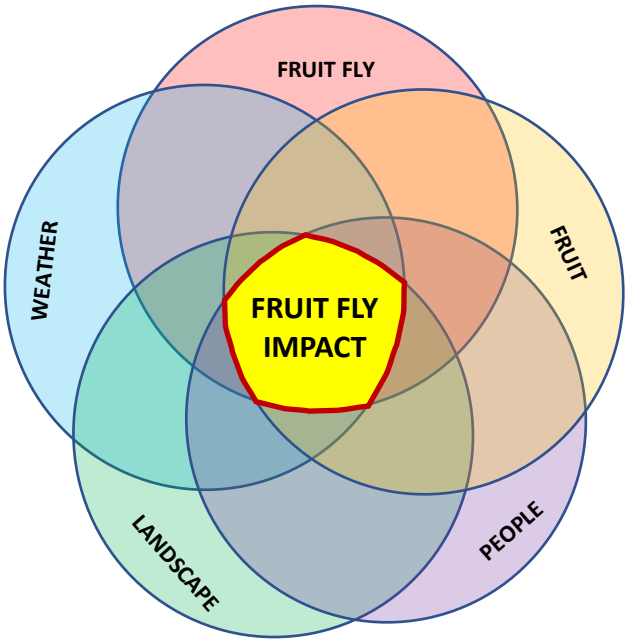
A high-pressure season is when fruit fly numbers are elevated above the general baseline level experienced in a region. It is the consequence of a complex interaction between the fly, fruit, people, weather and landscape.

Economically significant pest fruit flies, such as Queensland fruit fly (Qfly) (*Bactrocera tryoni*, Froggatt), impact seriously on production and productivity of crops grown by the home gardener and commercial orchardist alike. Growers must spend time, effort and money on protecting their crops from Qfly and, if they do not, their crops will be damaged and not saleable to domestic or international markets.

Qfly is currently the most economically significant pest fruit fly in eastern Australia. The Mediterranean fruit fly (Medfly) (*Ceratitis capitata*, Wiedemann) is absent from eastern Australia, however it is common in parts of Western Australia.

This article is focused on the Greater Sunraysia Pest Free Area (GSPFA) in North West Victoria.

Figure 1: Qfly impacts the GSPFA as the result of a complex interaction between the fly, fruit, people, weather and landscape.



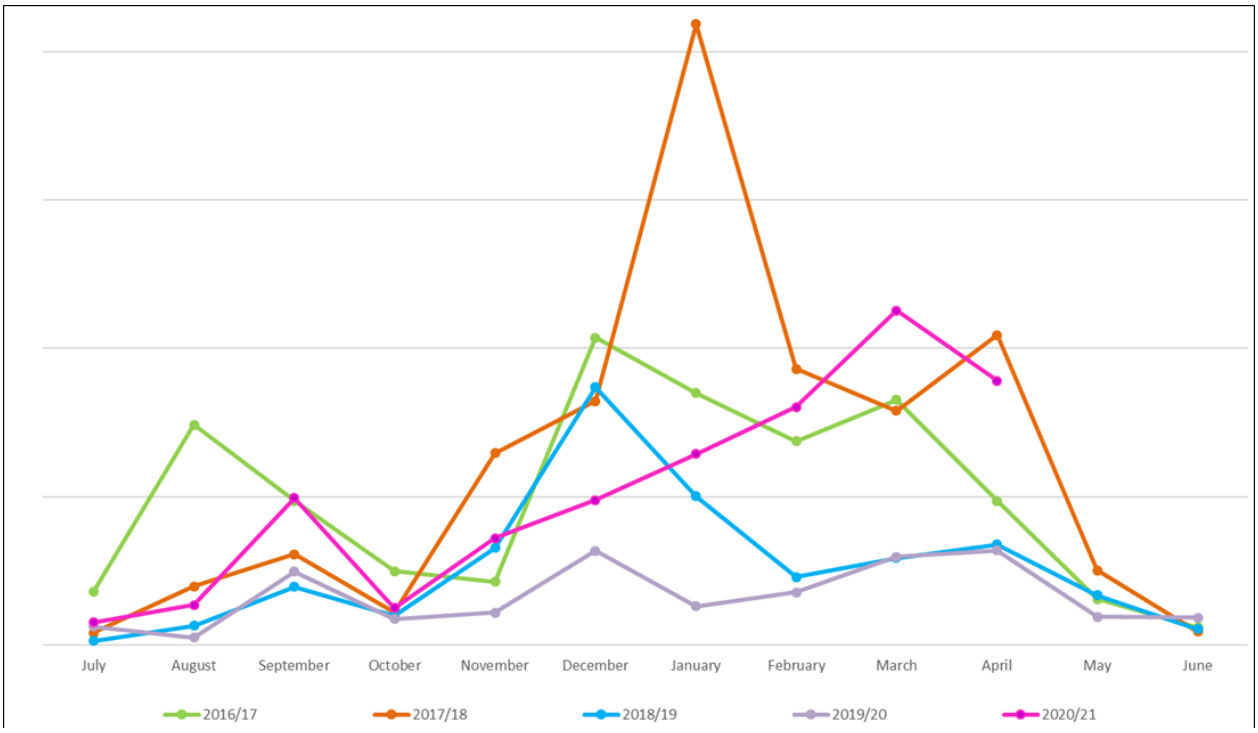
The effects of weather and fruit availability on Qfly

Figure 2 below shows 2017/18 was a high-pressure year for fruit fly in the GSPFA, especially during January 2018 which recorded a record number of Qfly in surveillance traps. This coincides with a key period for commercial crops in the region, particularly in the southern area with stone fruit ripening.

The end of the 2016/17 season showed very high residual Qfly populations in March to April. This puts pressure on the region the following spring when these flies moved out of their winter refuges to hunt for mates and host fruit. Higher-than-average rainfall in early spring and late summer of 2017/18 promoted fruit fly expansion in the summer of 2018. Following this very high-pressure year, low rainfall during winter, spring and summer of the 2019/20 season helped to see a significant drop in fruit fly numbers that year.

Fruit fly management is a complex interaction of fly and fruit biology, people, weather and landscape. The program has commenced untangling this and will continue to do so over time – as more people become aware of the problem and how to manage it.

Figure 2: Comparison of Qfly trapped per month in the GSPFA trapping grid (1150 traps) from 2017 to 2021



Basic requirements for a "bad" fruit fly year

In the GSPFA, fruit fly populations build up mainly due to large numbers of adult Qfly coming out of autumn-infested fruit. These flies then move into protected warm spots on the landscape and take refuge there over winter. When spring comes, they move out, mate and infest fruit to set up the next generation. All they need is favourable weather during autumn, the right dusk temperatures for mating, and plenty of ripening or ripe fruit in which to lay their eggs.

1. Favourable weather

All you need for a bad fruit fly year is a warm and moist autumn followed by a warm winter, then a moist spring and a cool, moist summer.

Figure 3: Basic requirements for a bad fruit fly year

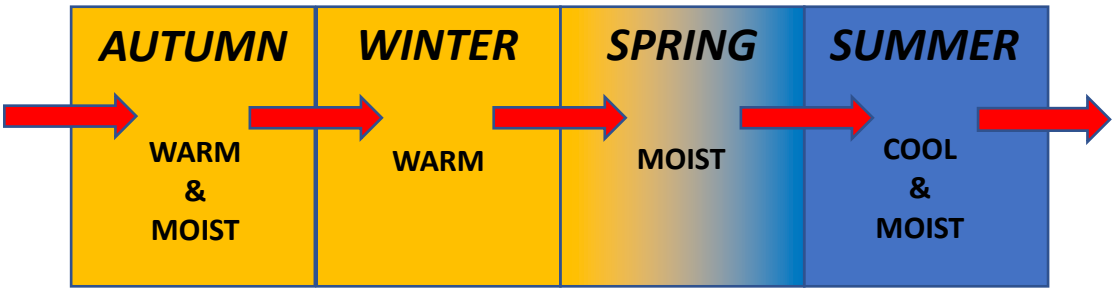


Figure 4 below shows the total monthly rainfalls recorded at Mildura Airport for July to February each year since 2017. The grey bays show the average monthly rainfall totals since records began in 1946 at Mildura Airport.

July to February 2017/18 was a bad period for fruit fly in the GSPFA. One reason for the upsurge in fruit fly numbers found in traps was the higher-than-average late winter/early spring and summer rainfall during those years.

The 2020/21 season is also shaping up as a bad year for fruit fly. There was a high residual population that went to traps in the spring of 2020. These flies found sufficient fruit to infest during September to November. However, there was limited rainfall in November and December 2020, resulting in fewer flies trapped. There must have been sufficient flies and fruit around in favourable situations (e.g. irrigated home gardens or house paddocks) during that time to keep a large Qfly population simmering. Then, in January 2021, high rainfalls encouraged Qfly survival and, potentially, infestation into autumn.

Fruit fly survival and population expansion are impacted by daily temperatures too. It is likely that adult and pupal Qfly are sheltered from the hottest days but eggs and larvae in fruit, especially fruit exposed to the sun (whether fallen or on the tree), are especially susceptible. However, heavy rains around the time of hot weather will mediate the impacts of heat on Qfly.

Figure 4. Total monthly rainfall in Mildura (BOM data from Mildura Airport) from March 2017/18 to February 2020/21 ("all years" data are averages from 1946 to 2021)

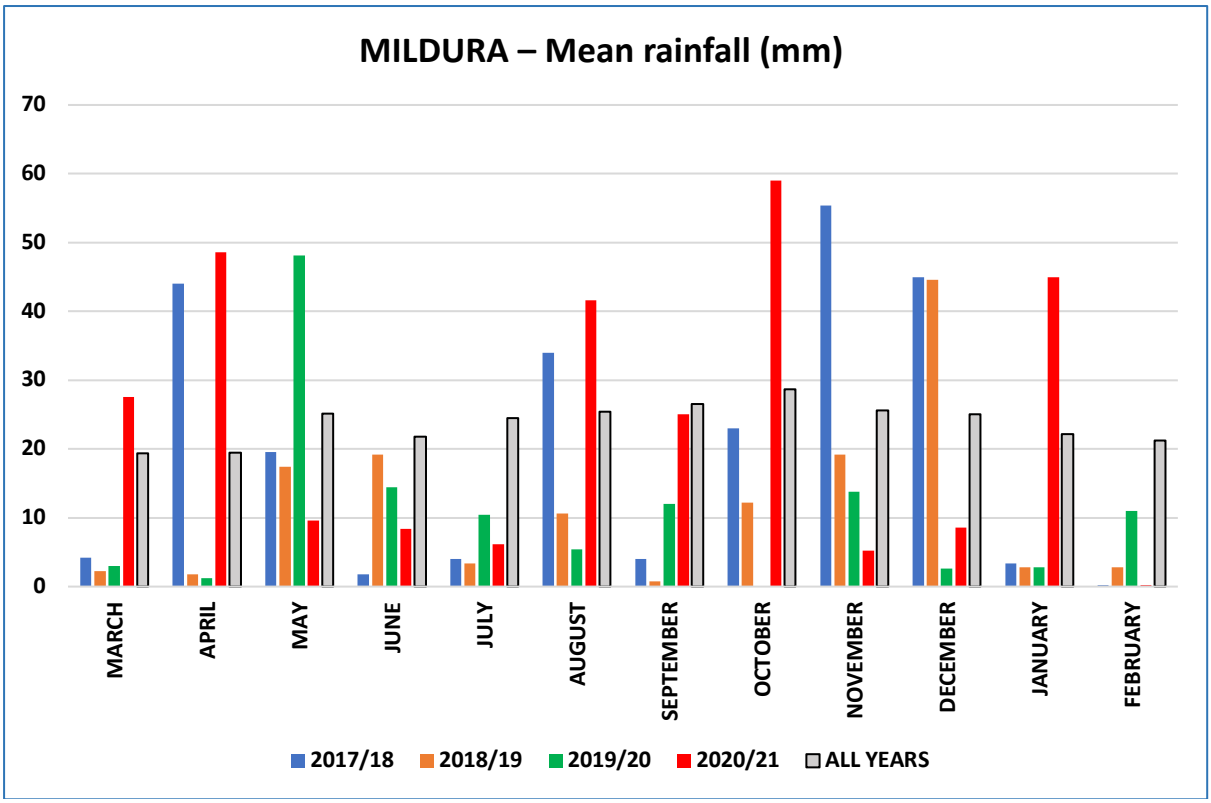
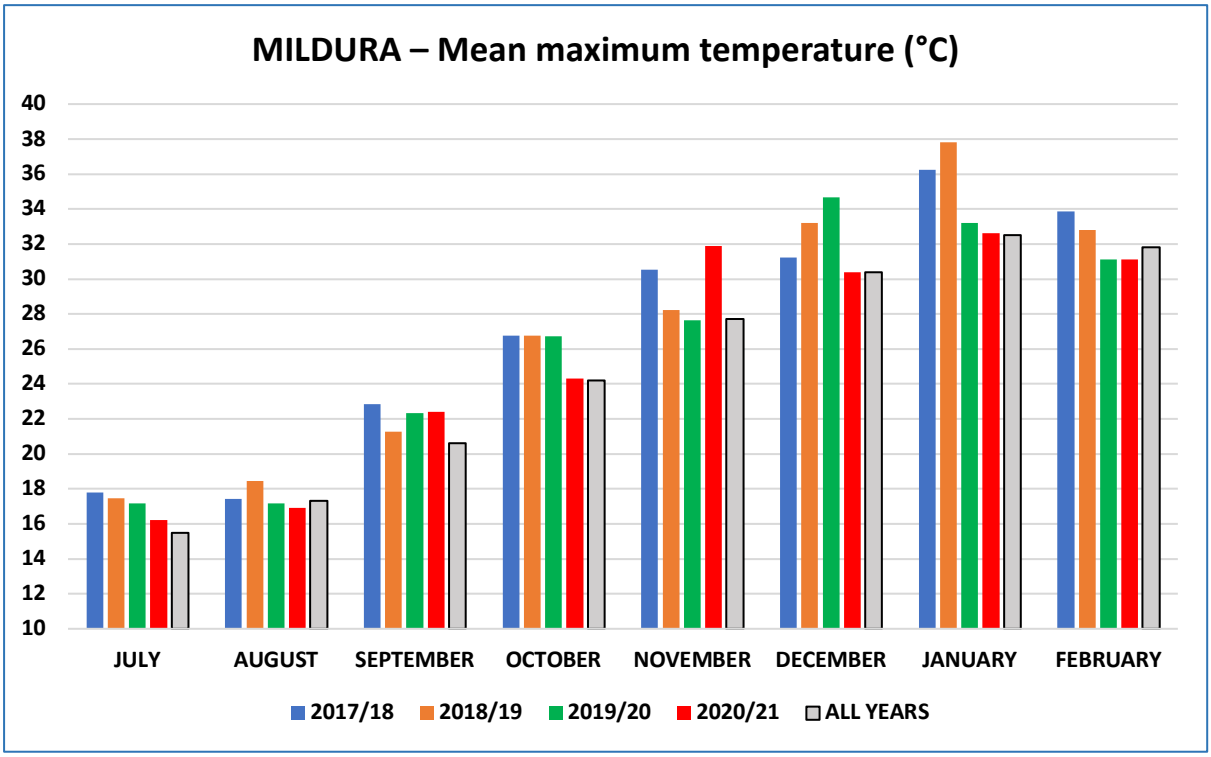


Figure 5: Average maximum temperatures in Mildura (BOM data from Mildura Airport) from July 2017/18 to February 2020/21 ("all years" data are averages from 1946 to 2021)



Higher-than-average rainfall promotes:

1. Higher bacterial, fungal and yeast growth due to higher humidity and lower maximum temperatures. Adult fruit flies feed on these organisms. This feed is essential for male and female fruit flies to reach sexual maturity.
2. Higher fruit set – more fruit for Qfly to infest, resulting in more fruit flies in the next generation.
3. More fruit that is larger and juicier – advantages Qfly oviposition and survival of greater numbers of eggs and larvae.
4. Higher relative humidity and soil moisture – improves survival of adults in the air and larvae, pupae and newly-emerged adults in the ground.
5. Lower maximum temperatures and higher minimum temperatures – also promote egg, larva, pupa and adult survival.

Higher-than-average maximum temperatures in the late spring and summer cause:

1. Reduction in bee activity and fruit set, resulting in fewer fruit flies.
2. Depending on fruit variety, high temperatures in the winter may reduce chilling hours and also lead to lower fruit set.
3. Reduction in natural feed for adult fruit flies (bacteria, fungi and yeasts).
4. Smaller, possibly drier fruit – less attractive to fruit flies and fewer fruit flies maturing per fruit – higher egg and larval mortality.
5. Increased adult fruit fly mortality due to lower relative humidity, increased pupal mortality due to lower soil moisture levels.
6. High egg and larval mortality in windfall fruit due to solarisation of exposed fruit on the ground.

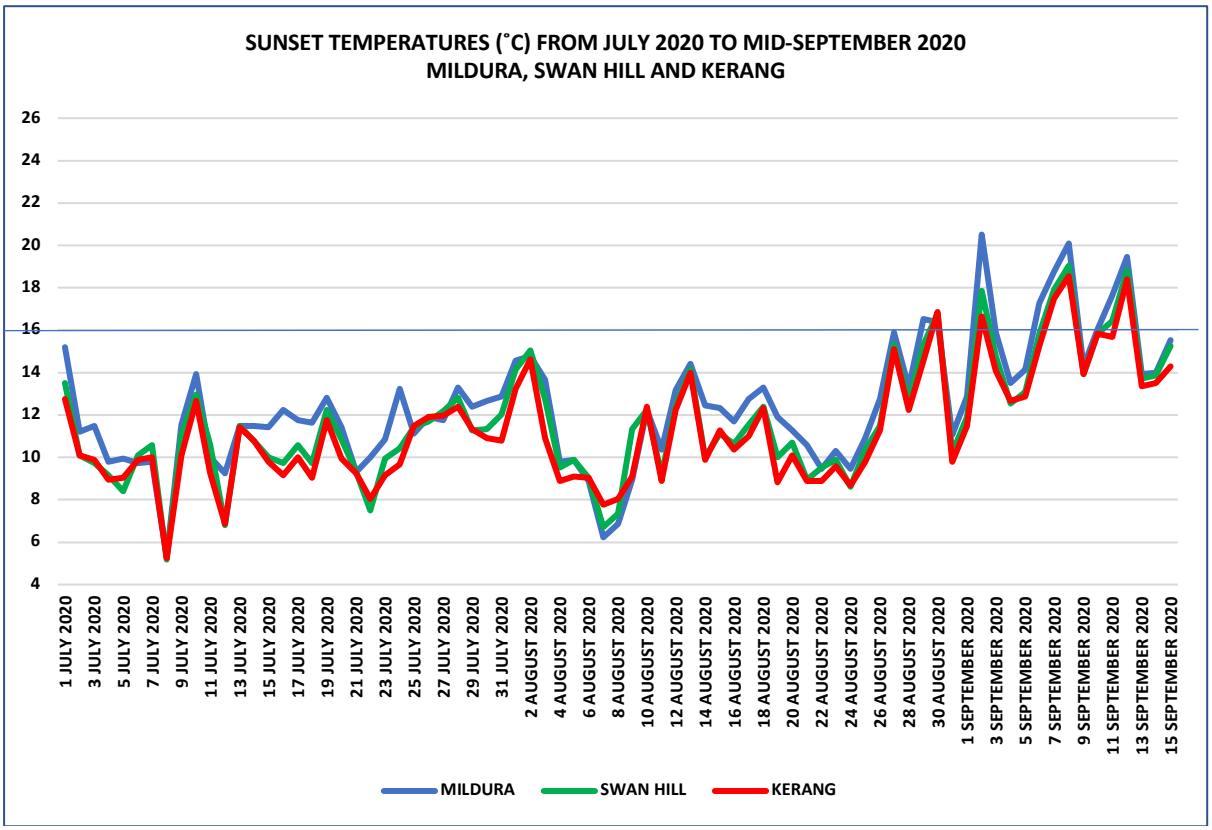
2. Warm dusk for Qfly mating

Secondly, and just as importantly, in areas of Australia with cool to cold winters, fruit flies need to mate after surviving winter. They mate only at dusk and only when dusk temperatures exceed 16˚C or so.

Figure 6 below shows that first possible mating events for Qfly in 2020 commenced in early September. This data was adapted from the Bureau of Meteorology (BOM) website. BOM data is accurate only for individual weather stations (e.g. Mildura's weather station is located at the Mildura Airport).

Temperatures within urban and rural locations around Mildura and the rest of the GSPFA may vary from BOM data by several degrees.

Figure 6: Estimated first mating times of Qld fruit fly after winter 2020



3. Something to infest

Thirdly, and also with high importance, fruit flies need a succession of ripening or ripe host fruit to infest. Host fruit could be growing in abandoned orchards or home gardens, in tended home gardens and commercial orchards and vineyards, or as feral plants along roadsides, creek banks and in the bush.

Table 1 below lists many of the Qfly host crops grown in the GSPFA. This list includes feral plants such as blackberry and prickly pear. Note that fruit ripening times will vary from place to place within the region and between varieties/cultivars.

Fruit ripening in March, April and May in the GSPFA is particularly dangerous as it can be the basis for a bad fruit fly year in the following spring, summer and autumn. Fruit flies maturing from autumn-infested fruit are the major origin of fruit fly populations in the coming seasons. The more fruit flies produced from these crops, the more that are able to survive winter and the greater the spring/summer fruit fly population explosion, with subsequent extra difficulty in controlling them the next season.

Table 1: Fruit ripening seasons in the GSPFA and risk of infestation by Qfly
(Note: Ripening times for various fruit and fruit cultivars vary from region-to-region)

CROP	EARLY			MID-SEASON					LATE			L-I
	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Apple	L						H	H	H	H	M	L
Apricot				H	H							
Avocado									L	M	M	
Blackberry						M	M	M				
Blueberry						M	M					
Cherry					L	M	H					
Citrus mixed	L	M	H	H	H	H	H	H	H	H	H	L
Eggplant							L	L	L	L		
Feijoa	L										H	L
Fig										H	M	L
Grape								L	L	L		
Grapefruit/ Pummelo	L	M										
Guava						H	H	H	H	H	M	
Indian fig/ Prickly pear									M	M	M	
Kiwifruit								H	M	M	M	
Kumquat				H	H	H						
Lemon/ Lime							M	M	M	M	M	L
Loquat	L	M	H	H								
Mandarin									H	H		
Medlar									L	L		
Mulberry	L	M	H	H	H							
NUT Chestnut Walnut Almond								L	L	L		
Olive	L											L
Orange summer					H	H	H	H	H	H	H	
Orange winter	L	M	H	H								L
Passionfruit				L	L	M	H	H	M	L		
Peach/ Nectarine/ Peacharine							H	H	H	H	H	
Pear							H	H	H	H	H	
Pear Asian/ Nashi						H	H	H				
Persimmon (astringent)	L								L	L	L	L
Persimmon (non-astringent)	L								H	H	M	L
Plum/ Plumcot									H	H	H	
Pomegranate									M	M	M	L
Prunus (street plantings)				H	H	H						
Quince	L										M	L
Raspberry						H	H	H	H	H		
Rose hip									M	L	L	L
Strawberry				L	L	M	M	M	M	L	L	
Tangelo	L	M	H	H	H							
Tomato/ Chilli/ Capsicum							H	H	H	H		

EARLY	Qfly build-up commences – low amount of damage	Fruit is infested in late winter to early summer by flies from the previous autumn that have overwintered. This is the source of population expansion during spring (which often goes unnoticed).
MID-SEASON	Population expansion – medium levels of damage	Hosts for subsequent Qfly populations assist in the rapid expansion of Qfly damage. The weather at this time of year is optimal for fruit fly survival.
LATE	Population consolidation – high levels of Qfly damage	Adults bred from fruit move to refuges to survive winter. They leave in spring (early season) and damage fruit in late spring/ early summer.
L-I (LOW IMPACT)	Eggs, larvae in fruit & pupae in soil die out – no damage	Unlikely sources of Qfly in the GMV – except in localised warm microclimates.

H	HIGH INFESTATION RISK	**L**	LOW INFESTATION RISK
M	MEDIUM INFESTATION RISK	**H, M OR L**	QFLY OVER-WINTERING RISK

Look out for the next report, coming soon, on the effects of the landscape and people on Qfly.

This information was compiled by Andrew Jessup of Janren Consulting for the May 2021 Greater Sunraysia Pest Free Area grower newsletter.