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Reducing the impact of plant and fruit diseases on strawberry production

Christopher Menzel, Apollo Gomez and Lindsay Smith (Department of Agriculture, Fisheries and Forestry), and Natalia Peres (University of Florida)

Strawberry production in south-east Queensland is severely affected by rain most seasons. The fruit can be damaged directly by rain, with water soaking, surface etching and cracking. There can also be an effect on pollination, with distorted berries following short periods of wet weather. Cultivars vary in their sensitivity to direct rain damage, however nearly all cultivars are affected when the fruit are mature. Mark Herrington and others showed that a rainfall event of 60 mm over three days on the Sunshine Coast resulted in a loss of more than 60% of fruit in 'Rubygem' and 'Festival'.

Strawberry production on the Sunshine Coast is also affected by fruit diseases, which are promoted by direct rain contact or by high humidity. These diseases are mainly grey mould (*Botrytis cinerea*), powdery mildew (*Podosphaera aphanis*) and stem-end rot (*Gnomoniopsis fructicola*). Powdery mildew and stem-end rot affect both the leaves and the developing fruit.

In severe seasons, up to 30% of the crop can be lost due to fruit diseases on

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the coast, equivalent to a loss of returns of about $60 million a year. Overall, grey mould is the main disease affecting the local crop, with stem-end rot being more of an issue after wet and windy conditions. Powdery mildew is more common after periods of high humidity but not heavy rainfall.

The main strategy used to control these diseases at the moment is to apply different fungicides throughout the growing season. However, there are several problems with this strategy. Some of the chemicals used are ineffective during wet weather, have limits to the number of applications allowed in a season, or may become ineffective in the long-term because of the development of resistance in the various fungi. There are numerous examples of the grey mould and related soft rot fungi becoming resistant to chemicals that are used for long periods.

Research overview

We are examining different production systems to reduce the losses associated with rain damage and fruit diseases for commercial strawberry growers on the Sunshine Coast. In the first part of the research, we are examining the potential of a range of chemicals as replacements for the fungicides currently used by industry to control the various fruit diseases, especially the control of grey mould. Some of the chemicals being evaluated have been investigated in strawberry fields in Florida.

In the second part of the studies, we are investigating the potential of high plastic tunnels to protect strawberry crops from rain damage and reduce the impact of grey mould and other diseases. Similar work has been conducted in Florida, although the emphasis has been on protecting the crops from frost damage.

In other research, Dr Natalia Peres from the University of Florida is examining the effect of different chemicals for the control of powdery mildew in strawberry plants growing under plastic tunnels. This disease can become a serious issue when strawberry plants are grown under protected cropping because the growth of the fungus is promoted by high humidity. This disease affects strawberry crops grown in Queensland and Florida.

Screening of chemicals for the control of plant and fruit diseases

Christopher Menzel, Apollo Gomez and Lindsay Smith

An experiment was set up to assess the effect of different chemicals to control fruit and plant diseases affecting strawberry fields in south-east Queensland. Bare-rooted transplants of 'Festival' were planted in mid-April in 2012 at Nambour. There were eighteen treatments in the experiment, using both standard and soft chemicals, and a nil control (see Tables 1 and 2). Data for the two plant extracts (NUL 2580 and NUL 2603) are presented for the higher of the two application rates. Data for the ascorbic, lactic and citric acid treatments are presented for the highest of the three application rates. The first spray applications were applied in late May, with the first fruit harvested in early July and the last fruit harvested in late September.

Thiram and captain are registered for use on strawberry plants in Australia. There are also registrations for iprodione (Rovral® and other products) and fenhexamid (Teldor®) for use on strawberry plants in Australia. Cyprodinil + fludioxonil (Switch®) isn't registered for strawberry plants in Australia, but does have a Minor Use permit (PER13539) covering its use for the control of grey mould and stem-end rot until March in 2013. None of the other chemicals used in this experiment are registered for their use on strawberry plants in Australia. The list of registered products and permits for strawberry production are available on the Australian Pesticide and Veterinary Medicine Authority (AVPMA) website (http://www.apvma.gov.au).

Fruit were harvested every week for an assessment of yield (fresh weight), number of fruit per plant and defects, including the incidence of various diseases. Mature fruit were classified as those that were at least three-quartered coloured. A record was kept of the number of fruit that were affected by rain and/or disease, along with those that were small (less than 10 g fresh weight) and/or misshaped, or that had other defects. Fruit that were affected by rain and diseases were rated as "diseased". Fruit that were small and misshaped were rated as "misshaped". The main disease affecting the crop was grey mould, with a very low incidence of powdery mildew, stem-end rot and black spot (*Colletotrichum acutatum*).

Data were also collected on daily rainfall at the site during the experiment. The plants were watered with over-head irrigation for about two weeks from 14 to 27 August to promote the development of grey mould during dry weather. During this time, the total amount of water applied to the crop by the sprinklers was 276 mm or about 21 mm per day.

Table 1. Effect of standard chemicals on yield and the incidence of grey mould in 'Festival' strawberry plants grown at Nambour in 2012. Data are the means of four replicates per treatment. Thiram was sprayed fourteen times, captan four times, iprodione four times, fenhexamid once, and cyprodinil + fludioxonil five times. All the other products were sprayed fourteen times. Iprodione = Rovral®; fenhexamid = Teldor®; cyprodinil + fludioxonil = Switch®; azoxystrobin + difenoconazole = Amistar Top®; and acibenzolar S-methyl is the plant defence promoter, Actigard®. Isopyrazam is not registered for commercial use in Australia at this time. DC-114 is an experimental product.

Treatment	Yield (g per plant)	Percent of fruit affected by grey mould
Control	780	38
Thiram and captan, with iprodione & fenhexamid	1557	4
Thiram and captan, with cyprodinil + fludioxonil	1443	3
Isopyrazam	1418	5
Product DC-114	1175	9
Azoxystrobin + difenoconazole	1006	19
Acibenzolar S-methyl	909	25

Total rainfall over the harvest period from early July to late September was 182 mm, with some weeks completely dry and other weeks receiving more than 50 mm. During the harvest period, there was some rain in seven out of the thirteen weeks. The over-head irrigation used from mid- to late August provided about another 300 mm of water to the canopy.

The incidence of the disease tended to increase after periods of heavy rain or when the over-head irrigation was turned on.

Some of the chemical treatments were effective in controlling grey mould, some were intermediate, and some were ineffective (see Tables 1 and 2).

The standard programs based on captan and thiram, with products iprodione and fenhexamid (registered), or cyprodinil + fludioxonil (permit) gave good control of the disease. The level of control was just as good using isopyrazam, and only slightly less with the experimental product DC-114. The other chemical product (azoxystrobin + difenoconazole) and the plant defence promoter (acibenzolar S-methyl), gave intermediate control.

The soft chemicals were ineffective or intermediate in their control of grey mould compared with the incidence of the disease in the nil water treatment (see Table 2). Plant extract No. 1 (two concentrations), potassium salts of fatty acids, and *Trichoderma* were rated as ineffective. Plant extract No. 2 (two concentrations), ascorbic, lactic and citric acids (three concentrations), potassium bicarbonate, and potassium bicarbonate + potassium salts of fatty acids were rated as intermediate in the control of the mould. None of these products were as effective as the better chemical fungicides.

Table 2. Effect of soft chemicals on yield and the incidence of grey mould in 'Festival' strawberry plants grown at Nambour in 2012. Data are the means of four replicates per treatment. Data for the two plant extracts are presented for the higher of the two application rates. Data for the ascorbic, lactic and citric acid treatments are presented for the highest of the three application rates. No information is available of the composition of the two plant extracts. All the treatments were sprayed fourteen times. The treatments with potassium bicarbonate also included an oil, which was phytotoxic to the strawberry plants. Ascorbic, lactic and citric acids = Citrex®; potassium bicarbonate = Ecocarb®; potassium salts of fatty acids = Ecoprotector®; and Trichoderma ***strain Td81 = Nemesis®.***

Treatment	Yield (g per plant)	Percent of fruit affected by grey mould
Control	780	38
Plant extract No. 1 (2 L/ha)	917	36
Plant extract No. 2 (2 L/ha)	666	30
Ascorbic, lactic and citric acids (2 L/ha)	696	30
Potassium bicarbonate	513	25
Potassium salts of fatty acids	799	33
Potassium bicarbonate + potassium salts of fatty acids	248	20
Trichoderma strain *Td*81	829	33

Yield was related to the incidence of grey mould, with the exception of the treatments that that were phytotoxic (see Figure 1). The two treatments that included potassium bicarbonate had lower yields than the untreated plants, despite some measure of disease control, reflecting damage to the developing canopy. It is possible that oil applied in conjunction with this chemical was responsible for the damage to the plants. There have been reports of similar damage to strawberry nursery plants in southern Queensland with these oils. There was no sign of phytotoxicity with the plant defence promoter (acibenzolar S-methyl), which has been reported to cause damage in other crops.

Yield was highest with the standard programs based on captan and thiram, with iprodione and fenhexamid, or with cyprodinil + fludioxonil, and with isopyrazam applied alone (see Tables 1 and 2). The yield of the plants given the experimental product, DC-114 was only slightly lower than the yield of the plants given these treatments.

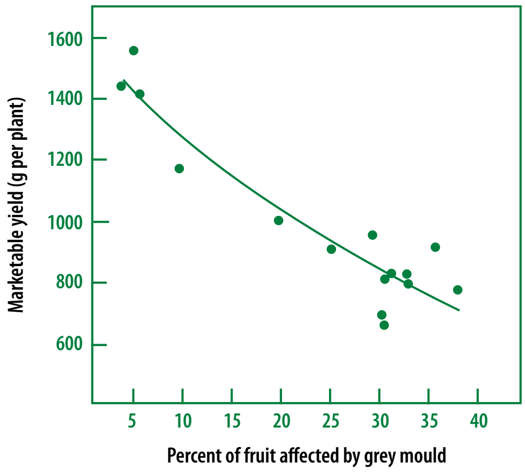


Figure 1. Relationship between marketable yield and the incidence of grey mould in strawberry plants in the fungicide screening experiment at Nambour in 2012. The two treatments that were phytotoxic were excluded from the analysis. Yield decreased as the incidence of the disease increased.

Evaluation of strawberry plants grown in tunnels under protected cropping

Christopher Menzel and Lindsay Smith

An experiment was set up to assess the potential of protected cropping to improve the productivity and economic returns of strawberry fields in south-east Queensland. Bare-rooted transplants of four cultivars, including Festival and Rubygem were planted in late March in 2012 at Palmwoods. The plastic structures used were standard 'Haygrove' tunnels, which are utilized extensively in the United Kingdom, Australia and other places (www.haygrove.co.uk). These tunnels were about 8 m wide and 5 m high. The plastic was placed over the plants growing in the tunnels in mid-May, while the sides of the tunnels were raised at the end of July to moderate temperatures during warm weather. Outdoor or open plots were used as controls.

Data were collected on plant dry weight about every four weeks from late May to mid-October. Fruit were harvested every week for an assessment of yield (fresh weight), number of fruit per plant and average fruit fresh weight. A record was kept of the number of fruit that were affected by rain and/or grey mould, along with those that were small (less than 12 g fresh weight) and/or misshaped, or that had other defects (mainly other diseases, surface bronzing or bird damage). Fruit that were affected by rain and/or diseases were rated as "diseased". Fruit that were small and/or misshaped were rated as "misshaped".

Four times over the growing season, eight sound mature fruit were collected from each plot for an assessment of post-harvest quality. The fruit from each plot were placed in 250-g punnets, and stored in the dark at 5^{0}C for five or six

days. They were then stored at room temperature for a further two days, and each fruit in the container scored for minor or major damage. The damage included cracks, water-soaking, major discolouration of the skin and diseases (mostly grey mould). Minor damage was a defect that would not likely to cause a consumer to reject the fruit in a commercial outlet.

Three times over the growing season, six sound mature fruit were collected from each plot for an assessment of total soluble solids content (Brix^0), and titratable acidity as citric acid. The fruit from each plot were placed in small freezer bags, and frozen until used for chemical analysis. The fruit for both of these experiments were collected after wet and dry periods.

Information was collected on daily minimum and maximum temperatures, and daily minimum and maximum relative humidities under the tunnels and in the outdoor plots from mid-May to mid-October. Data were also collected on daily rainfall close to the site during the experiment.

Total rainfall over the harvest period from late May to mid-October was 357 mm, with some weeks completely dry and other weeks receiving more than 50 mm. During the harvesting period, there was some rain in 12 out of the 20 weeks (see Figure 2).

The average daily maximum and minimum temperatures under the tunnels during the study from mid-May were 26.0^0 and 11.9^{0}C compared with 26.5^0 and 10.5^{0}C in the outdoor plots. The respective average daily maximum and minimum relative humidities were 94 and 44% under the tunnels, and 98 and 42% in the outdoor plots. It can be concluded that temperature and humidity conditions in the two growing areas were fairly similar.

Table 3. Effect of protected cropping on plant dry weight, marketable yield, and average seasonal fruit fresh weight in strawberry plants grown on the Sunshine Coast in 2012. Plants were grown in open plots or under plastic tunnels. Data are the means of four replicates per treatment. The fruit were harvested every week from the end of May to mid-October. Plant dry weight includes the mass of the leaves, crowns and roots. Average seasonal fruit fresh weight is the long-term average value of fruit fresh weight pooled across all harvests.

Cultivar	Plant dry weight (g)		Yield (g per plant)		Average fruit fresh weight (g)	
	Open plot	Tunnel	Open plot	Tunnel	Open plot	Tunnel
Festival	35.7	36.8	882	1246	18.9	20.7
Seedling 1	20.8	19.4	756	979	28.2	28.0
Seedling 2	21.5	21.7	577	738	24.1	24.3
Rubygem	27.6	29.6	667	1001	21.5	21.0

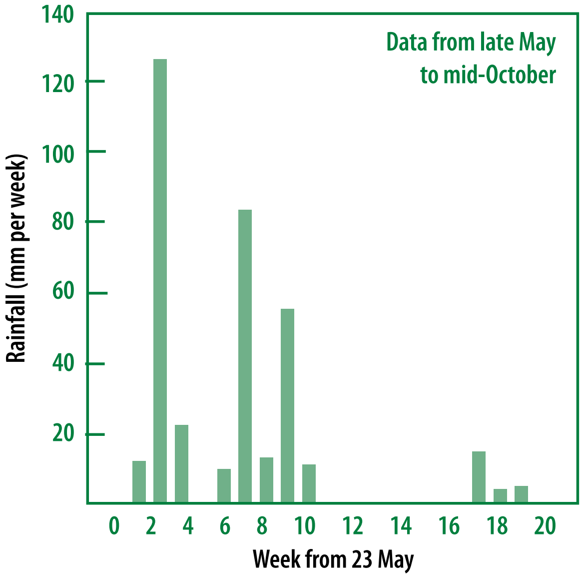
Average plant growth over the season was similar in the plants growing in the tunnels and the outdoor plots (see Table 3). In contrast, the 'Festival' plants had the highest plant dry weight, followed by 'Rubygem', and then the two seeding cultivars. Growing system did not appear to affect total vegetative plant growth.

Total marketable yield was higher in the plants grown under the tunnels than in the plants grown in the outdoor plots (see Table 3). There were also differences in productivity amongst the different cultivars. The relative order for increasing yield across the two growing systems was Seedling line 2, 'Rubygem', Seeding Line 1, and then 'Festival'.

The highest yield was obtained for the 'Festival' plants growing under the tunnels, and the lowest yield was obtained for Seedling line 2 plants growing in the outdoor plots. Growing system had no effect on the pattern of cropping, with similar relative fruiting in the plants growing in the tunnels and the open plots over the production season.

Table 4. Effect of protected cropping on the percent of fruit with various defects in strawberry plants grown on the Sunshine Coast in 2012. Plants were grown in open plots or under plastic tunnels. Data are the means of four replicates per treatment. The fruit were harvested every week from the end of May to mid-October. Other defects not presented include other diseases, skin bronzing and bird damage.

Cultivar	Rain damage and/or mould in open plot	Rain damage and/or mould in tunnel	Small and/or misshaped in open plot	Small and/or misshaped in tunnel	All defects in open plot	All defects in tunnel
Festival	12	4	23	22	37	26
Seedling 1	15	6	18	17	37	24
Seedling 2	18	7	15	14	38	23
Rubygem	19	7	29	29	51	36
Average	*16*	*6*	*21*	*21*	*41*	*27*



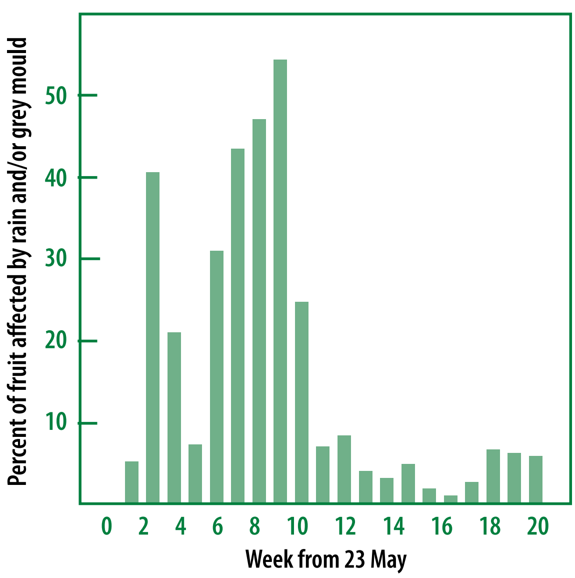


Figure 2. Relationship between the percent of fruit affected by rain and/or grey mould, and rainfall in the plants growing in the outdoor plots during the protected cropping experiment in strawberry in 2012. Data are pooled across the four cultivars. The incidence of rain damage and mould tended to be higher during or soon after periods of heavy rain.

Average seasonal fruit fresh weight was similar in the two growing areas, apart from slightly larger fruit in the 'Festival' plants growing under the tunnels (see Table 3).

Average losses of production across the four cultivars due to fruit defects were greater in the plants grown outdoors than in the plants grown in the tunnels (see Table 4). On average, total losses were about 50% more in the outdoor plots than in the tunnels. About a third of the losses in the outdoor plots were due to rain damage and/or grey mould. The rest of the fruit were mainly culled because they were small and/or misshaped. Overall, the plants grown in the two different environments had similar numbers of these defects. The plants tended to have misshaped fruit after cool nights in winter, while small fruit were more common towards to the end of the growing season during warm weather.

Total losses were least with 'Festival' and the two seedling lines growing under the tunnels, and greatest with 'Rubygem' growing in the outdoor plots (see Table 4). About 30% of the 'Rubygem' fruit in the outdoor plots and tunnels were rejected because they were too small and/or misshaped. Across the four cultivars, up to half the fruit were affected by rain and/or grey mould after wet weather (see Figure 2). Overall, 'Rubygem' was more susceptible to these issues.

There were insufficient data to determine a close relationship between rain damage and/or grey mould, and rainfall in different periods. There was some evidence of damage with rainfall of 20 mm per week, and some evidence of carryover of damage across different harvests from wet to dry periods.

Over the different harvests, there was no consistent effect of growing system on brix° (sugars) and acidity levels or on the post-harvest quality of the fruit.

The difference in marketable yields between the two growing systems is equivalent to an increase in gross margins of about $30,000 per hectare for the plants growing under the tunnels. This analysis takes into account the higher harvesting and marketing costs associated with the larger crop under the plastic, but not the extra costs of the structures. There is also the possible benefit of reducing planting and growing costs by producing similar crops on smaller planted areas.

The control of powdery mildew for strawberry crops growing under protected cropping

Natalia Peres

The effect of different chemicals to control powdery mildew in strawberry crops growing under plastic tunnels was investigated in Florida. The incidence of this disease is often increased when strawberry plants are grown under protected cropping. Bare-root transplants from Canada were planted in a high plastic tunnel in mid-October in 2011. The 17 different treatments, along with a nil water control were applied every seven to fourteen days from early December 2011 to mid-February 2012, with a backpack sprayer.

Foliar colonization by the powdery mildew fungus was evaluated by removing one leaflet from each of ten plants per plot in mid-March 2012, and scoring ten microscopic fields per leaflet for the presence or absence of mycelia (fungal threads). Foliar colonization was expressed as a percentage of positive fields per leaflet and averaged for all ten leaflets per plot.

Fruit were harvested twice a week from late December 2011 to late February 2012, and the number and weight of marketable fruit recorded. Fruit with visible symptoms of powdery mildew on more than 25% of the achenes, and other unmarketable fruit were also counted. The incidence of the disease was expressed as a percentage of all marketable and unmarketable fruit.

Symptoms of powdery mildew on the foliage such as leaf curling and reddening were common in December, but less evident later in the season. Overall disease pressure on the fruit during the season in Florida was light.

Table 5. Effect of different chemicals on the incidence of powdery mildew in strawberry plants grown under plastic tunnels in Florida in 2011/12. Fruit with conspicuous powdery mildew on more than 25% of the achenes were considered diseased. Data are the means of four replicates per treatment. Pyraclostrobin + fluxapyroxad = Merivon®; quinoxyfen = Quintec®; triflumizole = Procure®; myclobutanil = Rally®; cyflufenamid = Torino®; azoxystrobin + difenoconazole = Quadris Top®; azoxystrobin + propiconazole = Quilt Xcel®; penthiopyrad = Fontelis®; difenoconazole + propiconazole = Inspire Super®; Bacillus subtilis *strain* QST-713 = *Serenade Max®; potassium phosphate = K-Phite®; potassium silicate = Silmatrix®; experimental product* Bacillus subtilis *var.* amyloliquefaciens = *NZBBA 1106. Data from Dr Natalia Peres.*

Treatment	Percent of fruit affected by powdery mildew	Percent of fields on each leaflet with powdery mildew
Pyraclostrobin + fluxapyroxad	11	2
Quinoxyfen	15	6
Triflumizole alt. with quinoxyfen	17	7
Myclobutanil alt. with quinoxyfen	18	7
Cyflufenamid alt. with quinoxyfen	18	10
Azoxystrobin + difenoconazole	18	19
Cyflufenamid alt. with triflumizole	16	26
Azoxystrobin + propiconazole	16	27
Penthiopyrad	21	33
Triflumizole alt. with *Bacillus subtilis* var. *amyloliquefaciens*	15	33
Difenoconazole + propiconazole	18	50
Tolfenpyrad + adjuvant	17	57
Bacillus subtilis + captan	32	80
Potassium phosphate + potassium silicate	16	80
Triflumizole + *Bacillus subtilis* var. *amyloliquefaciens*	24	82
Streptomyces violaceusniger	19	83
Bacillus subtilis + thiram	44	98
Control	25	81

Late in the season, all but five treatments reduced foliar colonization compared with the water control (see Table 5). Pyraclostrobin + fluxapyroxad (Merivon®) and quinoxyfen (Quintec®) alone or alternated with triflumizole (Procure®), myclobutanil (Rally®), or cyflufenamid (Torino®) were effective. *Streptomyces violaceusniger*, NZBBA 1106 (*Bacillus subtilis* var. *amyloliquefaciens*) and Serenade Max® (*B. subtilis* strain *QST-713*) alone did not affect colonization of the fungus on the leaves. All three of these products are biological agents, and their effectiveness may have been negated by the high temperatures under the tunnels.

The combination of potassium phosphate (KPhite®) and potassium silicate (Silmatrix®) was also ineffective, possibly due to the formation of clear gel-like aggregates after mixing, although fruit colonization was reduced.

More of the treatments reduced powdery mildew on the foliage than reduced the disease on the fruit. The incidence of the disease on the fruit ranged from 11 to 44% and mostly from 11 to 25%. Only five treatments reduced powdery mildew on both the foliage and the fruit: pyraclostrobin + fluxapyroxad (Merivon®), quinoxyfen (Quintec®) alone, azoxystrobin + propiconazole (Quilt Xcel®), cyflufenamid (Torino®) alternated with triflumizole (Procure), and triflumizole alternated with NZBBA 1106 (*Bacillus subtilis* var. *amyloliquefacien*s).

There were no differences in marketable yield amongst the different treatments (4398 to 6875 kg per ha), suggesting that the level of the disease in the leaves and the fruit did not affect productivity. There were also no symptoms of phytotoxicity with any of the chemicals. Further experiments are required to develop effective strategies to control this disease in susceptible cultivars.

Implications of the research and future activities

The standard program based on captan and thiram, with the products iprodione and fenhexamid, or cyprodinil + fludioxonil gave good control of grey mould and high yields in strawberry plants growing on the Sunshine Coast. The level of control was just as good using isopyrazam, and only slightly less with the experimental product, DC-114. The other chemical products or soft chemicals gave poor or intermediate control. Cyprodinil + fludioxonil (Switch®) isn't registered for strawberry plants in Australia, but does have a Minor Use permit (PER13539) covering its use for the control of grey mould and stem-end rot until March in 2013.

The better treatments along with other strategies will be assessed in further experiments in 2013 at Nambour. It is possible that some of these treatments might include soft chemicals applied alternatively with main-stream fungicides. There are some reports of this strategy working in the control of fungal diseases in other crops. For instance, workers in the United States indicated that *Streptomyces lydicus* (Actinovate®) alternated with triflumizole (Procure®) gave good control of powdery mildew on summer squash and cantaloupe in Florida. This approach could be used to reduce the development of fungicide resistance in the populations of the pathogen.

We are currently assisting studies to help revise the label for the use of thiram in strawberry crops in Australia. Depending on the results of residue testing, an application will be made to reduce the withholding period for this product from seven to three days. Efforts to change the label for captan have been unsuccessful.

If the revised label for the use of thiram in Australia allows for a shorter withholding period (two to three days compared with the current seven days), it might be possible to develop a strategy for the strawberry industry based on weekly applications of the chemical for part of the growing season. This would reduce the need for multiple applications of alternative chemicals that the grey mould fungus is likely to become resistance to over the long term. The current label for the use of captan on strawberry plants only allows

for a maximum of five applications per season. This will limit the use of the product for the foreseeable future.

Experiments conducted on the Sunshine Coast showed that strawberry plants growing under plastic tunnels were more productive than plants growing in outdoor plots. The plants growing under protected cropping had fewer reject fruit, mainly due to a lower incidence of rain damage and/or grey mould. About half of the fruit produced in the open plots were rejected during wet periods. Further experiments are planned for 2013.

In other research conducted in Florida, different chemicals had a variable effect on the control of powdery mildew in strawberry plants growing under plastic tunnels. Some chemicals were more effective than others, even during a season when the incidence of the disease was relatively low. Further studies are currently being conducted in Florida.

Researcher profiles

Christopher Menzel

Dr Menzel is a Principal Horticulturist for DAFF and has conducted research for the strawberry industry in Australia for the past eight years. Chris led recent research that examined transplant agronomy, and the control of crown rot and lethal yellows in strawberry fields. He is currently leader of research examining the potential of protected cropping of strawberry plants on the Sunshine Coast. Chris also leads the work being conducted with Apollo Gomez and Lindsay Smith to screen chemicals for the control of plant and fruit diseases in strawberry crops.

Apollo Gomez

Mr Gomez is a Research Scientist for DAFF and has been involved in research on diseases in strawberry plants for more than ten years. Apollo contributed to the recent work that developed strategies for the control of crown rot affecting strawberry fields in southern Queensland. His main interest at the moment is to develop better methods to control the major fruit diseases affecting the crop on the Sunshine Coast. Apollo is responsible for co-ordinating the inspection of the nursery plants grown on the Granite Belt each year for the local fruit industry. He also assists the strawberry industry to apply for permits and registrations for new chemicals.

Lindsay Smith

Mr Smith is a Technical Assistant for DAFF and has been involved in many aspects of horticultural research for the past twenty years. He has provided support for projects on strawberry transplant agronomy, entomology and plant pathology. Lindsay is currently assisting the studies on protected cropping and fruit diseases in strawberry plants growing in south-east Queensland.

Natalia Peres

Dr Peres is an Associate Professor from the University of Florida in the United States. Natalia's main area of research is on fruit and plant diseases affecting strawberry crops. She has conducted research on the genetics and pathogenicity of different groups of the crown rot fungi. Dr Peres has also investigated different strategies for the control of grey mould, powdery mildew and black spot, important diseases affecting the crop in Florida and Australia. Natalia leads a team of plant pathology specialists at the University of Florida and has supervised several post-graduate students. Dr Peres has strong links with the research program at DAFF, and is currently assessing chemicals for the control of powdery mildew in strawberry plants growing under plastic tunnels.

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Not all the chemicals mentioned in this report are currently registered for use on strawberry nursery or fruit production fields. Please check current registrations for strawberries before using any of the chemicals. The product label is the official authority and should be used to verify all data relating to the use of a chemical.