

How much rain is too much? The impact on cotton colour grade

■ By Simone Heimoana and Lewis Wilson

COTTON lint colour is an important quality parameter that significantly contributes to the price at which cotton can be sold. Several factors may affect lint colour, including weather conditions, boll maturity, insect activity (honeydew) and microbial agents. Some of these factors interact with each other, for example, climatic conditions that enable fungal growth on cotton lint that has a high sugar content due to immaturity or insect factors.

The lint of newly opened undamaged mature cotton bolls is white and clean because cellulose, its primary component, is highly reflective and has not yet been exposed to the factors that can diminish this property, thereby altering cotton colour. Cellulose is built from plant sugars which disappear as the fibre matures, so immature fibres retain some stickiness. The cotton fibre is covered by a waxy cuticle that helps to repel moisture but



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it does not make the open boll impermeable to water.

Weathering, which is the exposure of open bolls to rain and UV radiation, can cause discolouration of lint, but the effect of UV radiation may be beneficial in situations where a short rainfall event followed by dry weather can have a bleaching effect on slightly discoloured lint. Such conditions may also reduce stickiness issues where cotton is contaminated with insect honeydew. In contrast, heavy or prolonged rainfall events are known to negatively affect lint colour and cause downgrades. The exact chemical processes that affect cotton colour during weathering are unclear but they may be related to the stripping of waxes, changes in fibre surface properties and microbial activity.

Moisture supports the actions of microbial agents such as bacteria and fungi. Amongst these, sugar feeding fungi such as sooty moulds often visibly dominate as seen by their production of black spores. While rain can wash honeydew off, even small amounts of residual honeydew can attract sooty mould fungi and while the risk of downgrades due to stickiness is reduced, the risk of downgrades due to discolouration from black spore contamination is increased.

Other fungi, such as *Alternaria*, can grow inside the lumen of the fibre, and fill the hollow core with dark spores that give contaminated cotton a grey appearance. While the industry is aware of the role of the various factors that influence cotton colour, specific baseline information, such as “How much rainfall



Cotton under cover ‘–Rainfall’ treatment (Control).



Cotton after the first 43.8 mm of rainfall.

is required to drop lint colour by one grade?" is not available. As part of a new CDRC project (CSP1703 *Investigating the relative contributions of weathering, insect honeydew and fungal agents to cotton colour grade changes and discounts*) we are aiming to address these issues over the next two years.

Early in 2016, we set up an experiment to assess rainfall effects on lint colour at ACRI in Narrabri, hoping that the crop would receive a couple of rain events before harvest. Almost miraculously, an unusually wet autumn enabled us to observe and assess the effects of cumulative rainfall as bolls were exposed to a total of 202 mm over 21.5 weeks. The experiment was set up at the end of February before first bolls opened. We covered some using two plastic greenhouses, so bolls opening under these shelters would not be exposed to rainfall, our '-Rainfall' treatment. Cotton adjacent to the greenhouses was used for the '+Rainfall' treatment.

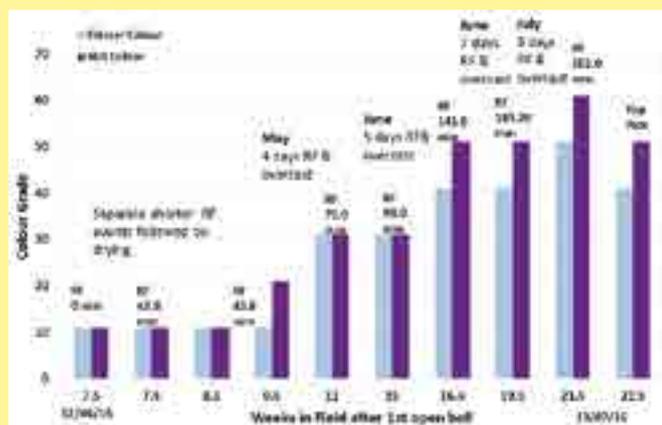
During boll opening the field received 20.4 mm of rainfall in four separate events between February 24 and April 10, none of which exceeded 8 mm. On April 11 (7.5 weeks in the field) the crop received a further 22.4 mm rainfall, so the next day we picked bolls from both the field and the tents. There were more rain events over the next 12 weeks and we continued to sample from the field after every rainfall event. We also collected a sample from the tents on May 6 to check if colour in the '-Rainfall' treatment was deteriorating as the bolls aged, even though they were not exposed to rain.

To ensure consistency, bolls were always collected from the lower area of the plant, about 1/3 up the main stem, as that stratum had been exposed to every rainfall event and reflected cumulative rainfall and time in the field since opening. All cotton samples were ginned on a small saw gin at ACRI and taken to Australian Classing Services (ACS) in Wee Waa for HVI testing and classing. They were subsequently sent to CSIRO in Geelong for spinning, weaving and testing, which is being completed.

The classing data for colour grade from ACS is shown in Figure 1. Colour grade is determined by a combination of greyness – that is, the degree of reflectance (Rd) which indicates how bright or dull cotton is; and yellowness (+b), which indicates the degree of colour pigmentation. The Australian base grade is Middling (31) but under optimal conditions, a large proportion of the crop can fall into Strict Middling (21) or Good Middling (11).

The initial rain events totalling 42.8 mm at 7.5 weeks of exposure did not affect the original colour grade of 11 (both by

FIGURE 1: Cotton colour grades – effect of field exposure and rainfall on lower canopy bolls, ACRI 2016



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classer and HVI) when compared to the ‘–Rainfall’ Controls (0 mm RF) in the columns on the left of the graph. But a further two weeks of field exposure caused lint to be downgraded to 21 by the HVI, though the classer still graded it as an 11. By week 11 (May) a further 27.2 mm of rainfall, which was associated with four overcast, cool days, caused a downgrade to 31. Cotton colour remained at that grade for the following four weeks in the field even though there was a further 20 mm more rain (week 15, 90.0 mm rainfall cumulative for the crop).

A further 51 mm of rainfall occurred during five overcast days which brought the cumulative total rainfall to 141.4 mm by week 16.5 (June). This resulted in grades dropping to 41 by classer and 51 by HVI. Cotton colour remained at those grades over the next three weeks to 19.5 weeks (July) even though there was a further 44.2 mm of rain during seven overcast days, bringing total cumulative rainfall to 185.6 mm. During the last two weeks in the field, the cotton experienced a further 16.8 mm of rain during five overcast days and cotton colour declined to 51 by classer and 61 by HVI (week 21, total cumulative rainfall 202 mm).

In comparison, cotton colour grade of controls picked at 11 weeks was still an 11, ie. it had not changed during that time (not shown on graph). Unfortunately our tents ripped during the June rain periods so no protected control bolls were available after week 11.

As a comparison with the older bolls, we also collected some bolls from the upper canopy at the last date (week 21.5, columns on the right labelled ‘Top Pick’). This ‘top pick’ cotton was also downgraded though not as severely as lower bolls, probably because it received less rainfall (unknown amount) and field exposure and may have dried out more quickly.



Cotton after 202.0 mm of rainfall after 21.5 weeks in the field.

Our experiment clearly demonstrates the detrimental effects of quantified, cumulative rainfall on exposed cotton lint. During the initial smaller rainfall events, there were periods of drying and possibly bleaching between rain events which may have mitigated potential negative effects on colour. From May onwards, rainfall events were accompanied by cloud cover over four to seven wet days, where drying of the crop was not possible, and after each of those periods, colour grade dropped. Classers graded cotton in favour of the grower, whereas, HVI picked up colour changes earlier and graded worse, especially as lint grade deteriorated.

With this experiment we have begun to investigate the role of rainfall effects on cotton colour and will endeavour to repeat this experiment. We will also follow up by investigating insect related honeydew/sooty mould effects on colour discounts, the relationships between the contributing factors and possible management tools. We would appreciate support from interested growers and consultants by notifying us of cotton fields contaminated with honeydew later in the season, rainfall exposure of open bolls and any sooty mould outbreaks. Please contact:

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Cotton from ‘Top Pick’ bolls – approximately 160 mm rainfall.