Cowpea aphids in lucerne-based pastures and photosensitisation of sheep

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Abstract
An outbreak of cowpea aphids (*Aphis craccivora*) on lucerne occurred in the Monaro region of the southern tablelands, NSW in spring 2020. Cowpea aphids infest various leguminous crops causing significant damage to host plants and have also been associated with photosensitisation in livestock grazing these crops. Despite a lack of available information, landholder extension was the key to rapidly warning graziers about the potential for livestock harm and the integrated measures available to manage the pest. Veterinary support also provided critical information about potential long-term health implications for livestock. Sporadic plant pest infestations are difficult to plan for and can cause significant disruption to farming systems. When the pest is not well understood scientifically, and technical information not readily available, this presents further challenges to the extension practitioners trying to assist graziers. We need to take the opportunities to investigate and document these issues when they arise to help inform the future management of outbreaks of sporadic pests.

Keywords
Cowpea aphids, lucerne, photosensitisation, Cesar Australia, technical information.

Introduction

Cowpea aphids (*Aphis craccivora*) affect plants from the family Fabaceae (legumes and beans) (Gutierrez et al. 1971). They are a worldwide pest that can not only stress their host plant but also spread several plant pathogenic viruses, causing up to 90% yield losses (Cesar 2020). Cowpea aphids have also been implicated in cases of animal photosensitisation since the early 1900s (Dodd 1916). The aphids are easily identifiable (Figure 1). The nymph is dull grey and the adult is black, and can grow up to 2 mm in length. Black and white leg marking are consistent across all life phases (Cesar, 2020). The winged adults are highly mobile and can spread vast distance on the wind (Gutierrez et al. 1974) and upon arrival on the host plant, can quickly colonise and reproduce (Gutierrez et al. 1971).

Figure 1. Cowpea aphids (*Aphis craccivora*) colonised many Monaro lucerne paddocks in September 2020.

This paper documents the key aspects of a significant regional outbreak of cowpea aphids on the Monaro (Southern Tablelands NSW) in 2020 where most lucerne paddocks across the region were impacted and thousands of sheep grazing these paddocks experienced severe photosensitisation.

Aphids and photosensitisation

Aphid infestations on crops and pastures have been associated with photosensitisation-like symptoms in livestock for over 100 years. Dodd (1916) summarised the numerous reports from NSW stock inspectors between 1911 and 1915 where unspecified aphids and the presence of trefoil in paddocks were implicated in outbreaks of "trefoil dermatitis" amongst sheep horses and cattle. The aphid species associated with these cases of reactive skin conditions in livestock were not identified.

McClymont and Wynne (1955) were first to suggest the direct link between ingestion of *Aphis craccivora* and photosensitisation in livestock following their identification of "considerable quantities" of photodynamic pigments in cowpea aphids colonising *Medicago denticulata.* However, low aphid number in following seasons prevented further test of this hypothesis.

Reed (1972) noted that one possible cause of "sunburn in livestock" from primary photosensitisation could be from the ingestion of *Aphis craccivora* on *Medicago denticulata* and *M. tribuloides* in pastures. This hypothesis was based on previous identification of a known photodynamic agent associated with the aphids (from an un-referenced source). Sporadic outbreaks of this possible aphid induced photosensitisation were noted previously in Victoria with, at times, over half the sheep in each flock being affected.

Ferrer et al. (2007) investigated experimentally the cause of primary photosensitisation in sheep following their grazing of lucerne that was heavily affected by *Aphis craccivora* as well as having high populations of the aphid predator, the seven-spot ladybird (*Coccinella septempunctata*). They found photosensitisation in sheep fed with macerated ladybirds that had been preying on the aphids. The presence of the cowpea aphids and the pathways of their potential impact to the livestock (oral ingestion of the aphid, oral ingestion of the ladybirds and/or via ingestion of a plant containing a photo toxin etc.) was not investigated.

A comprehensive review of photosensitisation diseases of animals by Collett (2019) identified *Aphis craccivora* as causing primary photosensitisation based on the isolation of a phototoxin. However, this paper noted that the direct link between aphid ingestion and photosensitisation had not yet been scientifically proven in feeding trials, despite some reporting of possible links from field observations. It is worth noting that we could not find literature with sufficient evidence to prove a direct link between cowpea aphid ingestion by livestock and subsequent photosensitisation.

Case Notes

Cowpea aphids on the Monaro

The Monaro outbreak of cowpea aphids was discovered in September 2020, following the reports of multiple mobs of sheep displaying symptoms of severe photosensitisation (Figure 2). Local Land Services (LLS) staff found pastures with 25-100% lucerne were the common element in all the reported cases. The lucerne was consistently affected by black aphids and a sticky honeydew-like residue on the leaf and stems. Most plants were stressed, with stunted growth and curled leaves, and plant mortality was also apparent.

Cesar Australia rapidly identified the aphid as *Aphis craccivora* and were able to provide information relating to possible aphid-related photosensitisation event in 2017 in South Australia involving over 25000 sheep. The timeliness of the pest identification and related information allowed LLS staff to send out warnings to all local agronomists and graziers within hours. With lucerne providing the only quality feed in many paddocks at that time, the risk of livestock exposure to the aphids was extremely high.

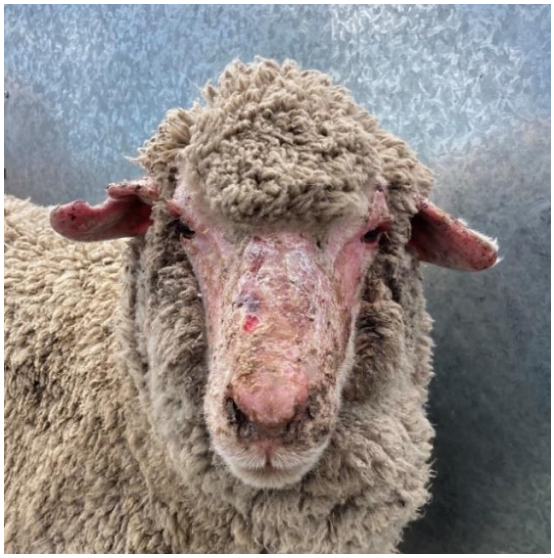

Figure 2. Severe photosensitisation in sheep was reported by many Monaro graziers in September 2020.

Seasonal conditions in the lead up to the outbreak had been mild in the region with above average rainfall in July (105 mm) and August (70 mm) but well below in September (14mm), fewer frosts than in previous years and above average minimum temperatures (BOM 2021).
By mid-October, aphid predators were becoming more notable in the paddocks with ladybird larvae and adults increasingly active across many paddocks. Predatory wasps, spiders and hoverfly were also observed. Widespread rainfall across the region in later October 2020 seemed to help bring the outbreak to a close, with reported aphid numbers significantly in decline and rapid lucerne growth in response to the soil moisture and improving growth conditions.

Challenges to the response
Much of the relevant literature found during the early stages of the outbreak referred only to managing cowpea aphids in annual crops or annual pastures. There was no information on aphid ecology with a temperate perennial host. Other unanswered questions were how long would the aphids remain active in the current season; would they survive in the mild climate over summer, and would they become an issue in following seasons.

Recent changes to insecticide registrations in NSW and the absence of any on-label treatments for cowpea aphids in lucerne complicated the initial advice to graziers seeking to control their aphids. NSW Department of Primary Industries, Farm Chemicals Unit prepared and lodged an application with the APVMA for an emergency use permit to address the situation. Permit 90173 was issued in early October 2020 by the APVMA.

Those who chose to pursue chemical control of the aphids reported varying success. The high volumes of water required for application and the challenging spray conditions no doubt added to the difficulties in getting sufficient plant coverage to kill the aphids effectively. Long withholding periods also meant that graziers were unable to utilise these paddocks for 2-4 weeks, during which aphid re-infestation often occurred.

Conclusion

The outbreak of cowpea aphids (*Aphis craccivora*) on lucerne across the Monaro in spring 2020 caused significant problems for drought affected graziers. Many questions were raised regarding the effective management of the aphid on lucerne as well as both the immediate effects of the photosensitisation and long-term implications for the affected sheep. Livestock losses were estimated by some affected graziers of between 10-20% of lambs in affected mobs as well as significant production losses in ewes, weaners and other stock classes from the photosensitisation related impacts.

Limited available information about management options for the aphids in a perennial pasture system and the implications for affected livestock challenged local advisors and veterinarians during the initial response. Cesar Australia provided crucial up-front support in rapidly identifying the pest involved and providing initial information about its management.

Ongoing field monitoring has commenced to provide further information about population behaviour and risks to livestock grazing lucerne. A longer-term study on affected livestock has started to identify animal health implications beyond the acute skin related damage.

There is still a need to rigorously test the direct link between oral ingestion of *Aphis craccivora* and the occurrence of primary photosensitisation. Whilst a photodynamic agent has been identified in cowpea aphids (McClymont and Wynne 1955), a direct association between ingestion of the aphids and subsequent photosensitisation remains unproven. There have been projects proposed to investigate this, but it is our understanding that they have not progressed.

It is hoped that through the documentation and publication of this occurrence of cowpea aphids in lucerne, and by highlighting the challenges in responding to this outbreak, it will raise awareness of the issues associated with managing such an event. Cowpea aphids and their interactions with livestock appear sporadically in both the literature and in nature, and only through gaining further understanding about their interactions in the environment can be make more informed decisions about managing our future responses.

References

Bureau of Meteorology (2021). Climate Data Online. (http://www.bom.gov.au/climate/data/index.shtml).

Cesar Australia (2020). Pest Notes – Cowpea Aphid. (https://cesaraustralia.com/pestnotes/aphids/cowpea-aphid/).

Collett, M (2019). Photosensitation diseases of animals - Classification and a weight of evidence approach to primary causes. Toxicon X3, 1000012.

Dodd, S (1916). Trefoil Dermatitis, or the Sensitisation of Unpigmented Skin to the Sun's Rays by the Ingestion of Trefoil. Journal of Comparative Pathology and Therapeutics 29.1 (1916): 47–62.

Ferrer LM, Ortín A, Loste A, Fernández A,Verde MT and Ramos, JJ (2007). Photosensitisation in sheep grazing alfalfa infested with aphids and ladybirds. The Veterinary record. 161. 312-3. 10.1136/vr.161.9.312.

Gutierrez A, Morgan D, & Havenstein D. (1971). The Ecology of Aphis craccivora Koch and Subterranean Clover Stunt Virus. I. The Phenology of Aphid Populations and the Epidemiology of Virus in Pastures in South-East Australia. Journal of Applied Ecology, 8(3), 699-721. doi:10.2307/2402678

Gutierrez AP, Nix HA, Havenstein DE and Moore PA (1974). The Ecology of Aphis craccivora Koch and Subterranean Clover Stunt Virus in South-East Australia. III. A Regional Perspective of the Phenology and Migration of the Cowpea Aphid. Journal of Applied Ecology, 11(1), 21-35. doi:10.2307/2402002

McClymont, GL and Wynne, KN (1955). The possibility of photosensitisation due to ingestion of aphids. The Australian Veterinary Journal, April, I955.

Reed, GA (1972). Sunburn of Livestock. Journal of Agriculture, Victoria, Australia. 70.12 (1972): 444–446. Print.