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Farms, fire and fuels: exploring the relationship between cropland fires and modern farming.

Rachel A N Westcott*
Western Sydney University, Sydney, New South Wales, Australia, and
Bushfire & Natural Hazards Cooperative Research Centre, Melbourne, Victoria, Australia.
R.Westcott@westernsydney.edu.au

Introduction

Crop fires in standing mature crop or stubble are hot, fast moving fires which behave differently from 'bushfire[1]', creating a very large firescar in a short time. The social, economic and environmental losses due to crop fires can be enormous, yet there is very little published research in either the academic or "grey" literature regarding fire aetiology or management, or the development of risk reduction strategies to address the inherent risk presented by thousands of hectares of dry matter fuel on broadacre farms. Modern plant breeding and conservation farming techniques maximise yield and help optimise the economics of farming; they also lead to very high fuel loads before, during and after harvest.

There is an urgent need for cropland fire research to build a body of work to understand the threat and management of crop fires and reduce the existing knowledge gap. This will proactively help to safeguard life, livelihoods, property, agricultural productivity and economics, food security, and the environment – with the ultimate aim being to protect people and their livelihoods in a hotter, drier climate with an increased risk of fire.

Data from key stakeholders are needed to define the relationship between fire and no-till farming, crop types and placement and the use of management tools such as firebreaks, managed gardens and the planting of garden trees. Actively building knowledge regarding cropland fire behaviour and developing risk reduction strategies will allow efficient, modern farming methods to continue to evolve economically and profitably while simultaneously managing and safeguarding a farm, its people and its produce as effectively as possible. Social, environmental and economic benefits can be expected. This paper (poster abstract #217) reports on a pilot survey included in this researcher's PhD thesis (Westcott, 2018).

In Australia, harvesting of grain crops usually occurs at the height of the fire season: crops up to two metres high cover thousands of hectares with densely planted dry matter, of varying flammability[2]. Despite these inherent risks, a literature search found no research targeting the aetiology, management and development of risk reduction strategies to address the threat of crop fires. A proactive approach to better understanding how crop types and farming techniques affect crop fire behaviour would contribute to managing, treating and reducing fire risk to farming communities, farm infrastructure, food production as well as domestic and international food security (Table 1).

*Rachel Westcott PO Box 1, Bridgewater, South Australia 5155; R.Westcott@westernsydney.edu.au OR coordinator@savem.org.au See also ptlincolnproject.wordpress.com

[1] 'Bushfire' is the Australian term for 'wildfire'.

[2] Different crop types (e.g. oilseed, cereal, legume, pasture) vary in flammability.

Research rationale and research questions

There is a massive gap in the literature regarding the problems of crop fires
Broadacre farms are at high risk due to climate change
Grain producers contribute significantly to the nation's *gross domestic product*
Data collected in the pilot survey strongly support the need for further research into managing the risk of fire in cropping land
Conservation farming, use of firebreaks and crop placement are key factors to consider
Data to be collected from grain producers, other key stakeholders and industry leaders. Findings to be trialled and evaluated, leading to further research

Table 1: *Rationale for future research*

Three research questions arose from considering the wider literature and earlier findings (Westcott, 2017c, Westcott, 2017a, Westcott et al., 2017a):

- Do conservation farming methods and techniques influence the severity of a crop fire, and if so, how does this occur?
- Can crop type and crop placement (such as proximity to dwellings or other infrastructure) be managed to treat risk and increase safety?
- Can the use of routine strategic firebreaks pre fire season help reduce risk, and manage crop fires?

Bushfires are increasing in Australia and worsening globally within temporal and geographic parameters: the corollary of climate change and increasing severe weather events (Intergovernmental Panel on Climate Change (IPCC), 2014, Kitching, 2014). In the pilot survey, respondent #45 commented: *The main human activity that is currently contributing to increased fire risk is our insistence on ignoring the effects of climate change.* Fire can become an emergency when people, property, the environment and other assets are affected: risk reduction strategies are essential to manage this increasing global threat and to protect industries potentially vulnerable to extreme weather conditions (Westcott et al., 2017b). Grain production is a highly productive industry in South Australia with respect to export and employment (Primary Industries and Regions South Australia, 2017a). Increased grain yield in the last two decades is due to advances in farming methods as well as hard work (Primary Industries and Regions South Australia, 2017b).

Two of the most destructive fires in South Australia this century have been the 2005 Wangary fire on Eyre Peninsula and the 2015 Pinery fire in the lower north of the state. Both fires occurred in standing mature crop or stubble - the speed and ferocity of the fires still astounds those who experienced them. Social, economic and environmental losses from the fires were enormous. The Pinery fire burnt approximately 86,000 hectares. There were two human fatalities and losses in grain and hay alone totalled AU$24m, with AU$75m in insurance claims during the first week after the fire (Australian Broadcasting Corporation, 2015, Primary Industries and Regions South Australia, 2015). The 2005 Wangary fire burnt approximately 79,000 hectares, 80% of which was highly productive agricultural land used for cereal, oilseed and pulse grain production, and extensive livestock grazing on improved pastures. Significant losses included 9 human fatalities, 93 houses, 237 sheds, approximately 47,000 livestock, and 6,300 kilometres of fencing, with property losses totalling around AU$100m (Egan, 2006, Schapel, 2007, South Australian Country Fire Service, 2016).

Literature review

The lack of academic literature regarding crop fires represents a serious and concerning knowledge gap. A search of the grey literature yielded only a farmers' *code of practice* (Government of South Australia, 2011), and no research was found concerning the relationship between crop fires and conservation farming. A search on the word "crop" yielded only one relevant 'find' in Bradstock (2010), where cleared land is referred to as *seasonally fuel free due to cropping or grazing*. This statement is misleading because (i) in conservation farming land is never truly fuel free, and (ii) the seasonal window where fire is unlikely is very narrow – a matter of a few months from germination post break-of-season (which may be well into winter) through the cooler months until early to mid-spring. New research will enable risk reduction strategies to be trialled to safeguard an economically valuable industry with highly significant investments in social and environmental capital.

Method

A survey with 54 questions was written using SurveyMonkey. The survey included a consent page and instructions for completing the survey. The survey was launched post-harvest but prior to seeding, with the link distributed on-line via agricultural groups, with the option for providing a hard copy. Eligible participants worked in primary production, as a farm owner, worker or manager, and were not required to have actual experience of fire on their farms.

Results and discussion

In total 53 responses were received, including one in hard copy, with 37 'complete' surveys. Data were collected from farmers located in South Australia and New South Wales (n=37): 81% of respondents had experienced fire on their farms. Seventy-five (75) per cent of respondents had been farming for more than 20 years, and 81% for three or more generations of their family. Two or more generations of the family are currently employed on 54% of farms. Farms ranged in size from four to 135,000 hectares: 56% (n=21) of farms were greater than 1000 hectares. Livestock and cropping were the most common farming systems utilised, with just over 40% (n=15) having either heritage or non-listed areas on-farm set aside and managed as significant native habitat and conservation areas.

Cropland fire and farming methods

Farmers were asked: ***do you think modern farming practices (e.g. no-till cropping and increased crop density) could contribute to altered fire behaviour?*** Fifty-five per cent (55%) of pilot survey responders answered "yes definitely", and 33% answered "yes possibly". In response to the question ***do you cut firebreaks in your paddocks,*** 43% answered "yes" and 43% "no", with 14% answering "sometimes". Data supported a review of the use of firebreaks as a possible contributor to managing risk on broadacre farms. Anecdotally, firebreaks have fallen out of favour in recent years, possibly due to the perception of economic losses they cause due to reduced area of crop. Firebreaks may not stop a fire, but they can help in strategically managing fire-containing activities (Westcott, 2017c).

Crop type and crop placement

Cereal crops, legumes and pasture all ignite and carry a fire differently, and oilseed crops such as canola are taller and burn faster (Westcott, 2017c). Farmers "Bob", "Paul" and "Trevor" (pseudonyms) each independently discussed how different types of crops "carry" a fire, and how growing more flammable crops further away from livestock and other assets could be a helpful consideration (Westcott, 2017c, Westcott, 2017a).

Bob said:

> *The biggest change probably has been the huge increase in oil seed with canola predominantly, which burns very, very fast [and] very, very hot and that's pretty hard to stop… There's a massive volume of crop material, but there's a huge residual as well, so the loads on the ground are just enormous. Crop yields have increased I would suggest by 50 percent over the last 20 years at least, so you've doubled the burnable material that's there to go up and so, of course, it goes like nuts.*

Trevor:

> *We're so prone to fires down here because everyone's intense cropping so you've got a lot more stubble, and so being able to stop a fire once it starts is very difficult. Pasture or legume crops, they wouldn't carry a fire as quickly as certainly your canola stubble would, so that's an option that the farmer would have, if there's stock or buildings nearby.*

Paul:

> *I think with our modern farming and agricultural techniques we're achieving crop yields that are way and above what we've ever been able to do in the past….in 30 years, I've seen cereal yields double, and what that means, of course, is that there's double the amount of crop residue over the summer period after the crops have been taken off, and the proportion of arable land going into crops has increased also. So we've got two contributing factors there - increased area of crop and also a greater crop residue, which adds to the fuel load.*

After the Pinery fire, a farmer who lost his breeding ewes observed:

> *While many people think canola stubble would be less of a fire risk than a thicker wheat stubble, this fire [Pinery] disproved that myth. The fire was ferocious, particularly through the canola stubble where the ewes were. (Reflections on the Pinery fire, p27). (Pinery Fire Community Action Group, 2016).*

Planting around assets

A well-maintained cleared space around buildings with low vegetation and/or plants of low flammability is essential, and if possible, a watered, green garden surrounding the home. This can help keep buildings safe. *Reducing the fuel load is a continual and continuous process during Spring*, noted respondent #23, and this needs to be understood by new residents.

Respondent #30, for example, was adamant his home and buildings were saved from a devastating fire by the surrounding deciduous 'English' trees which effectively damped down the approaching fire front. Respondent #24 similarly wrote about plants reducing the hazard of fire to buildings: *If possible grow lucerne*[3] *around house / sheds it shuts fire down. The two best defences I saw [at the] 2005 fire were high tin fences and patches of lucerne*.

Selective planting around homes and buildings has been documented as a fire retardant strategy and is a readily achievable, short and long term strategy to enhance fire preparedness (Ramsay and Rudolph, 2003, Delaine and Rural Solutions SA, 2012). Modern broadacre grain producing farms are enterprises with valuable infrastructure, machinery and multiple buildings. They may include livestock, and sometimes are involved with conserving or re-establishing native vegetation. Protection of these assets can be enhanced by achieving a better understanding of the influence of adjacent planting - ranging from surrounding crops to a watered garden containing lawns or irrigated grasses or leguminous plants, and stands of

[3] Lucerne is the Australian name for alfalfa.

deciduous European trees such as oaks, elms, non-suckering ash and liquidambars. Less flammable trees such as these may help damp down a fire approaching a dwelling or other infrastructure.

Modern agricultural science – plant breeding and soil science – and no-till conservation farming techniques have resulted in highly productive farms with healthier soils containing more organic matter that are able to support strong plants with higher grain yields. Consequently, economic benefits to farming families, communities and to the nations' gross domestic product (GDP) are increased. However, different crop properties combined with increased plant density per hectare mean more organic matter on the ground, and hence more fuel in the event of a fire.

Pilot survey results strongly suggest modern, productive conservation farming techniques contribute to dangerous fire conditions (Westcott, 2017c, Westcott, 2017b, Westcott, 2017a, Westcott et al., 2017a). Establishing updated and informed best practice management plans, protocols and/or codes of practice with respect to reducing the risk posed by crop fires to people, property, the economy and the environment is an important mitigation strategy within and beyond the agricultural sector.

Conclusion

Understanding the influence of modern farming techniques upon crop fire behaviour and identifying and developing strategies to treat and manage that risk aims to help reduce risk to people, their environments and livelihoods, the state and national economy and to global food production. Consequently, this will allow efficient, modern farming methods to continue to evolve economically and profitably while simultaneously proactively managing and safeguarding a farm and its produce as effectively as possible by reducing the potential risk of a crop fire. Social, environmental and economic benefits can be expected.

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