The development of a harvester integrated impact mill for devitalising weed seeds

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Summary Herbicide resistant weeds are one of the biggest threats to grain production and, hence to global food security. To reduce the reliance on herbicides for weed control, mechanical weed control can be achieved at harvest time by capturing and killing weed seeds in the chaff fraction by milling the chaff. To integrate mechanical weed control into the harvester a completely new mill was needed that was designed for purpose. *Lolium rigidum* Gaudin (annual ryegrass) seeds were chosen as the target weed species because of its abundance and ability to develop herbicide resistance. Initially, the fundamental impact requirements to devitalise *Lolium rigidum* seeds was determined. The number of impacts and impact speeds needed were determined by impacting seeds with a rotational impact tester. A computational fluid dynamics particle study was used to model the number of impacts and impact speed in different concept impact mills that were compact enough to be integrated into a harvester. The particle study data and the fundamental impact requirements were used to predict seed devitalisation and then determine the best concepts. The two best concepts were constructed and evaluated in the lab and the seed kill showed good agreement with the particle study model. Harvest time mechanical weed control offers grain growers a cost effective way to supplement and support herbicide usage without significantly affecting their harvest operation.