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Short communication

Response of three potato (*Solanum tuberosum*) cultivars to pyraflufen-ethyl used as a desiccant in Canada

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Abstract

At present, in Canada, there are only three desiccants available for use in potato production to remove haulms prior to harvest. The new herbicide pyraflufen-ethyl was evaluated as a haulm desiccant and for its effect on daughter tuber sprouting the following spring. Field trials were carried out in four seasons. Stem desiccation was not improved by increasing doses of pyraflufen-ethyl above 10 g ai ha^{-1} except on the variety, Russet Burbank, at 60 g ai ha^{-1}. Pyraflufen-ethyl gave slower desiccation at 7 and 14 days after treatment than diquat but desiccation was comparable 21 days after treatment. Splitting the total dose into two applications, 5 days apart, reduced early desiccation but had no effect on final desiccation level. Pre-treatment with pyraflufen-ethyl improved level of desiccation at 7 and 14 days after treatment compared to the single application and to diquat; however, final desiccation level was not affected. The cultivar, Yukon Gold, was most easily desiccated with Russet Burbank and Shepody being comparable but slower. Tuber stem end discolouration and marketable yield were not affected by pyraflufen-ethyl in any year on the cultivars tested. Pyraflufen-ethyl had no effect on number of eyes that sprouted or sprout weight on daughter tubers when compared with untreated controls.

Keywords: Diquat; Tuber sprouting test; Varietal response; Field trials

1. Introduction

At present, there are only three desiccants available for use in potato production to remove haulms prior to harvest in most potato producing areas of North America. Diquat and endothall are used on crops for all uses as both have no effect on daughter tuber sprouting (Ivany and Sanderson, 2001; Ivany, 2004) and glufosinate-ammonium, which is used only on processing and table crops as it affects daughter tuber sprouting (Ivany and Sanderson, 2001). The herbicide pyraflufen-ethyl was introduced as a new herbicide for control of broadleaved weeds in cereals in 1993 (Miura et al., 1993). Pyraflufen-ethyl is a contact-type herbicide and causes rapid necrosis and desiccation of stems and leaves in the presence of light (WSSA Herbicide Handbook Committee, 2002, p. 374). No research has been reported on the efficacy of pyraflufen-ethyl as a desiccant of potato cultivars or effects on potato daughter tuber sprouting.

The present study was conducted to determine the efficacy of the desiccant pyraflufen-ethyl compared to the standard desiccant diquat for foliar desiccation on three potato cultivars. Experiments were conducted on the most appropriate dose to apply and to compare desiccation with a single full dose application compared to a split application five days apart. The effect of the addition of diquat to pyraflufen-ethyl as a split application or as a mixture was also examined. The

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effect of the desiccant on tuber sprouting the next spring was examined on daughter tubers retained and stored overwinter.

2. Materials and methods

Field experiments were conducted from 1998 to 2002 at Charlottetown, Prince Edward Island. The cultivars Russet Burbank, Shepody and Yukon Gold were evaluated for their response to pyraflufen-ethyl applied as single doses of 10, 20, 30 and 60 g ai ha^{-1} in 1998. In 2000, split applications of 5 + 10 and 10 + 10 g ai ha^{-1} were compared to single applications of 20 g ai ha^{-1} and pyraflufen-ethyl was compared to diquat at 137.5 g ai ha^{-1} as the second part of the split with desiccation evaluations being taken from date of first application of the desiccant. In 2001, pyraflufen-ethyl was used as a pre-treatment at 5 and 10 g ai ha^{-1} and followed by 5 g ai ha^{-1} or diquat at 137.5 g ai ha^{-1} and compared to pyraflufen-ethyl as a single treatment at 10 g ai ha^{-1} or diquat used alone at 275 g ai ha^{-1} on Russet Burbank cultivar only, but taking desiccation evaluations from date of the split application of the desiccant. In 2002, rates of application were 7.5 to 7.5 and 5 + 10 and 10 + 10 g ai ha^{-1} of pyraflufen-ethyl compared to a single treatment of 15 g ai ha^{-1}. A treatment of diquat at 275 g ai ha^{-1} alone and at 275 + 275 g ai ha^{-1} was also evaluated on Russet Burbank cultivar.

The experiments were conducted on a fine sandy loam soil (Orthic-Humo-Podzol containing 60.4% sand, 29.0% silt and 10.6% clay). Soil pH and organic matter ranged from 6.0 to 6.6 and 2.8% to 3.0%, respectively. Fertilizer was applied banded as 15–15–15 at 950 kg ai ha^{-1} at planting. Seed pieces were machine planted at 25 cm in-row spacing for Yukon Gold, at 38 cm for Shepody and 45 cm for Russet Burbank. Plots were three rows wide with 0.9 m between rows with rows 6.0 m long in all years. Planting dates were May 21, June 1, May 30 and May 23 in 1998, 2000, 2001 and 2002, respectively. Each cultivar was evaluated in separate experiments designed as randomized complete block with four replicates. All data was collected from the centre row of the plot.

Metribuzin was applied pre-emergence at 0.5 kg ai ha^{-1} in all years to provide control of annual weeds. Desiccant treatments were applied with a tractor-mounted, small-plot sprayer which delivered a spray volume of 300 L/ha at a pressure of 275 kPa. Desiccant treatments were timed to be applied at first signs of start of haulm maturity and varied slightly from year to year. Desiccant treatments were applied to Russet Burbank on September 18, 23, 10 and 10 in 1998, 2000, 2001 and 2002, respectively, to Shepody on August 31 and September 6 in 1998 and 2000, respectively and to Yukon Gold on August 31 and 29 in 1998 and 2000, respectively. The treatments consisted of untreated control, and pyraflufen-ethyl as single applications at several doses as well as split applications without different adjuvants. Treatments of diquat at different doses of application were included for comparison. Potato leaf and stem desiccation after desiccant application was visually rated at 3, 7, 14 and 21 days after first treatment (DAT) on a linear scale of 0–100 where 0 = no effect and 100 = kill of the leaf or stem, except in 2001 and 2002 when ratings were taken after application of the second treatment.

The centre row of each plot was mechanically harvested on October 14, 23, 10 and 16, in 1998, 2000, 2001, and 2002, respectively for Russet Burbank, on September 29 and October 23 in 1998 and 2000, respectively for Shepody and on September 11 and 22 in 1998 and 2000, respectively for Yukon Gold. Tubers were mechanically weighed and grouped into classes of smalls (<45 g) Canada No. 1 size (45–330 g), large size (>330 g). Weight for each size class was determined and total plot yield was calculated.

In the fall of 1998, 2000, 2001, and 2002 daughter tubers were retained and stored overwinter at 3 C and 95% RH for determination of stem-end discolouration (SED) and tuber sprouting. SED was evaluated using a method developed by Bowers et al. (1996). Tubers were cut longitudinally through the stolon attachment point and a 6.1 × 6.1 mm^2 grid placed on the cut surface. The number of grid squares with discolouration was recorded. Daughter tuber sprouting was determined in March–April of the following year, five months after harvest. A total of 25 tubers per plot, ranging from 150 to 250 g weight were placed stem end down in a rack and placed in a dark growth cabinet set at 20 C and 90% to 95% RH. After 28 days in the growth cabinet, the total number of sprouts that were greater than 2 mm in length were counted and fresh weight of sprouts per tuber were obtained.

The data from each experiment were analysed using ANOVA techniques (Genstat 5 Committee, 1987). The data for each year is presented for desiccation ratings, potato yield and tuber sprout weight on daughter tubers.

3. Results and discussion

3.1. Pyraflufen-ethyl doses—1998

Desiccation on all three cultivars was very rapid in 1998 and all had 100% haulm desiccation by 21 DAT. Pyraflufen-ethyl, at all doses, gave lower leaf desiccation at 7, 10, and 14 DAT than diquat but by 21 DAT, leaf desiccation was complete (data not presented). Pyraflufen-ethyl gave less stem desiccation than diquat at 7,