INTRODUCTION OF ALLELOPATHY TO WHEAT: EFFECT OF *TRITICUM SPELTOIDES* ON TWO WEEDS OF WHEAT

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Summary The allelopathic effect of 19 accessions of *Triticum speltoides* on wild oat (*Avena fatua* L.) and 8 accessions of *T. speltoides* on Indian hedge mustard (*Sisymbrium orientate* L.) was evaluated in two separate experiments using an agar diffusion method. These experiments were conducted as part of a broad attempt to evaluate the allelopathic effect of 29 accessions of *T. speltoides* on several weeds of wheat. Pre-germinated seedlings of surface sterilized caryopses of *T. speltoides* were transplanted to cellulose dialysis tubing (CDT) filled with 0.5% agar. The CDT was placed in a plastic box filled with 1 L of 0.5% agar. Sterilized caryopses of wild oat in Experiment 1 and seeds of Indian hedge mustard in Experiment 2 were sown onto the cooled agar surface of each box around the CDT. Among the 19 *T. speltoides* accessions tested against wild oat, the accession 9 inhibited root length of wild oat. Among the 8 accessions of *T. speltoides* tested against Indian hedge mustard, accessions 8 and 10 inhibited radicle length of Indian hedge mustard.

INTRODUCTION

Allelochemicals affect germination, growth, development, distribution and behaviour of plants including weeds (Wink 1987, Fujii *et al.* 1995). Alteri (1988) and Einhellig and Leather (1988) proposed allelopathy as an alternative weed management strategy. Einhellig (1995) emphasised that work should continue on practical application of allelochemicals and the allelopathic phenomenon. Putnam and Duke (1974) have selected for allelopathic activity when breeding weed-controlling cultivars of cucumbers. Macias (1995) suggested that genetic transfer of allelopathic traits into commercial crop cultivars may be one way of developing new crops with the ability to suppress weeds. *Triticum speltoides*, a wild and close relative of wheat, is reported (Brennan personal communication) to possess allelopathic potential. If an allelopathic trait is present in *T. speltoides*, it may be possible to introduce this to wheat by a wide hybridization and embryo rescue method to obtain a wheat variety with a natural weed suppression ability. As an initial step in the project to introduce allelopathy to wheat, these experiments were conducted to evaluate the allelopathic potential of 29 accessions of *T. speltoides* on wild oat and Indian hedge mustard.

MATERIALS AND METHODS

Treatments Allelopathic effects of 29 accessions of *T. speltoides* were tested against wild oat (Experiment 1) and 8 accessions against Indian hedge mustard (Experiment 2) with two replications using the Plant Box Method (Fujii *et al.* 1995).

Sterilization Seeds of all species were surface sterilized by washing the dehusked seeds in 70% ethanol for three minutes and soaking in 3% sodium hypochlorite solution for 10 (Indian hedge mustard) to 20 minutes (wild oat and *T. speltoides*) followed by three rinses in sterilized water.

Pre-germination of *T. speltoides* seeds and seedling raising The sterilized seeds of *T. speltoides* were pre-germinated on agar. In Experiment 1, three-day-old *T. speltoides* seedlings were transplanted to cellulose dialysis tubings (CDT) filled with 0.5% liquid agar. In Experiment 2, 56-day-old seedlings were transplanted onto CDT. A sterilized square plastic box (1.5 L) was filled with 1 L of 0.5% agar. The CDT was placed in the centre of one side of the box and was held by a specially engineered holding frame. The allelochemicals produced by *T. speltoides* were able to diffuse through the CDT and subsequently through the agar to the test species.

Sowing of wild oat and Indian hedge mustard After transplanting *T. speltoides* seedlings into the CDT, 30 sterilized seeds of wild oat and 150 of Indian hedge mustard were planted onto the surface of the agar using a template to obtain 10–80 mm distances between the centre of the CDT and the farthest seed. After sowing the wild oat and Indian hedge mustard, the boxes were wrapped with a transparent cling wrap film to reduce evaporation from agar surface.

Measurement of roots Each seedling was carefully uprooted at six weeks after sowing in Experiments 1 and 2 weeks after sowing in Experiment 2 and root or radicle length was measured. Experiments on the effect of *T. speltoides* on Indian hedge mustard and wild oat are in progress and more experiments on sowthistle (*Sonchus oleraceus* (L.) A. Love), climbing buck wheat (*Fallopia convolvulus* L.) paradoxa grass (*Phalaris paradoxa* L.) and wheat will be the topic of future studies.

Data analysis Data were subjected to a regression analysis. A scattered plot diagram along with the regression equation was generated for each accession of *T. speltoides* using the distance between the CDT and test species seedlings as independent variable and the root/radicle length as dependent variable.

RESULTS

The regression equations generated for the root length of wild oat seedlings show that 18 of the 19 accessions of *T. speltoides* tested in Experiment 1 did not affect the root growth of wild oat seedlings in agar. The *T. speltoides* accession 9 (AUS No. 21645) inhibited the root length of wild oat. In the linear regression equation for *T. speltoides* accession 9, the intercept ($P<0.0001$) and slope ($P<0.0001$) were significant (Figure 1). Although the intercepts ($P<0.001$) of linear regression equations for speltoides accession 4, 7 and 16 were significant, the slopes ($P>0.05$) were insignificant (Figure 1). The results of the other 15 accessions tested in Experiment 1 were similar to accessions 4, 7 and 16. Out of the 8 (AUS No. 21643) *T. speltoides* accessions tested against Indian hedge mustard in Experiment 2, the intercept ($P<0.0003$) and slope ($P<0.0002$) of the regression equation for accession 8 were significant (Figure 2). The intercept ($P=0.002$) and the slope ($P=0.007$) of the accession 10 (AUS No. 21646) were also significant (Figure 2). However, in the regression equation for accessions 2 and 6, the intercepts ($P<0.0001$) were significant but the slopes ($P>0.05$) were insignificant. The results of the other four accessions in Experiment 2 were similar to the accession 2 and 6.

DISCUSSION

The slopes of *T. speltoides* accession 9 tested against wild oat and accessions 8 and 10 tested against Indian hedge mustard were significant. The significant slopes of the regression equations for these accessions indicate that

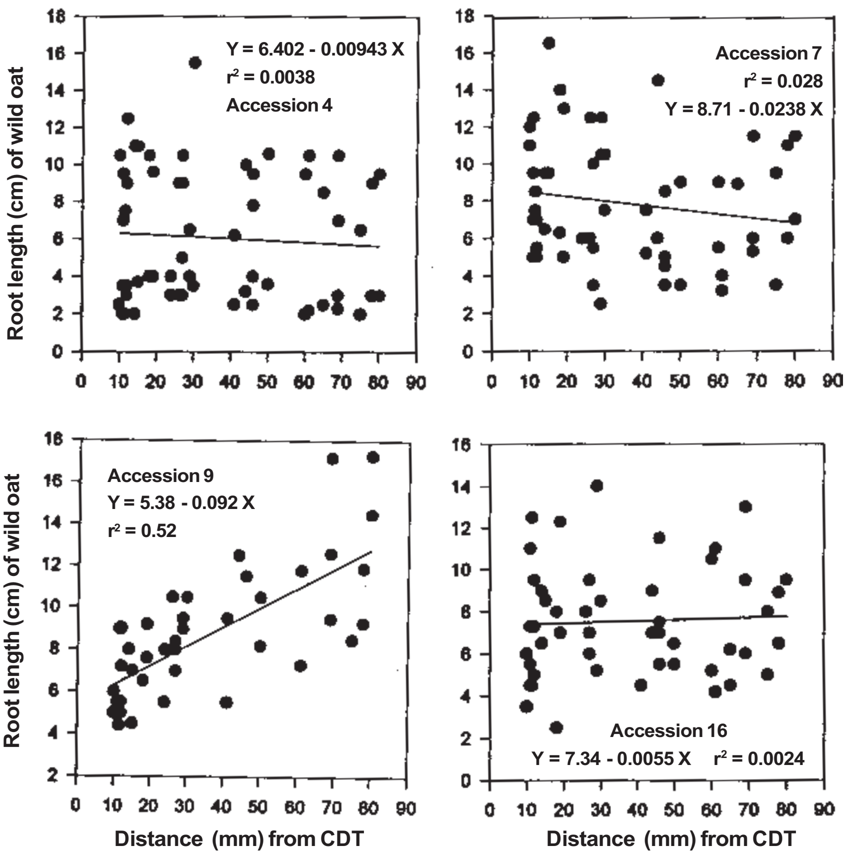

Figure 1. Simple linear regression relationships quantifying the allelopathic effect of accessions 4, 7, 9 and 16 of *T. speltoides* on the root length of wild oat seedlings sown in agar 10–80 mm away from the seedling of *T. speltoides*.

T. speltoides accession 9 reduced root length of wild oat and accessions 8 and 10 reduced radicle length of Indian hedge mustard.

In Experiment 1 the proximity of accession 9 seedling alone accounted for 52% of the total variation in root length of wild oat up to six weeks after sowing. On the average, the root lengths of wild oat seedlings sown 10–20 mm away from the *T. speltoides* seedling of accession 9, were reduced by about 37% compared to those sown 50–80 mm away. In Experiment 2 the proximity of accessions 8 and 10 alone accounted for 42 and 29% respectively of the total variation in radicle length of Indian hedge mustard up to two weeks after sowing. On the average, the radicle length of Indian hedge mustard sown between 10–20 mm away from the *T. speltoides* seedling was reduced 50% by accession 8 and 18% by accession 10 seedlings compared to those sown 50–80 mm away. The insignificant slopes of 4, 7 and 16 in Experiment 1 (Figure 1) and accessions 2 and 6 in Experiment 2 (Figure 2) indicate that these accessions did not affect root growth of the test species.

The results of these two experiments indicate that the accessions 8, 9 and 10 may be a potential source of allelopathic genes that could be transferred to wheat to obtain weed suppression ability in wheat. Macias (1995) also suggested that genetic transfer of allelopathic traits to related commercial crop may be one way of developing new crops with the ability to suppress weeds. Since the r^2 values of the regression equations were rather low and the experiments were conducted in agar, further evaluation in soil medium is necessary to confirm the allelopathic effect of *T. speltoides* on wild oat and Indian hedge mustard.

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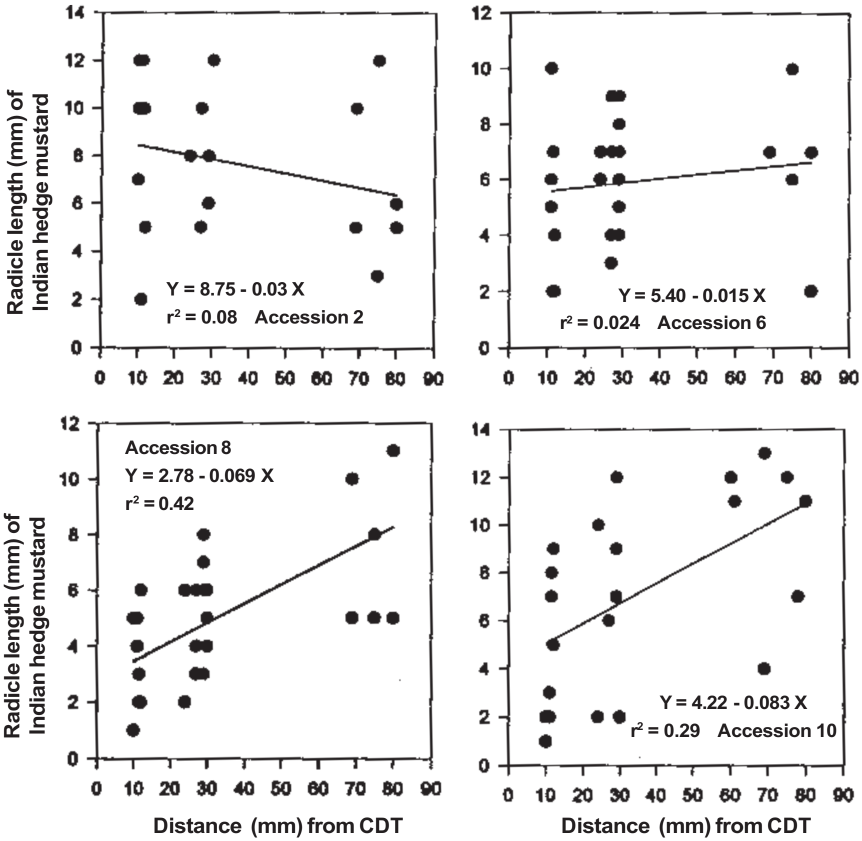

Figure 2. Simple linear regression relationships quantifying the allelopathic effect of accessions 2, 6, 8 and 10 of *T. speltoides* on the radicle length of Indian hedge mustard seedlings sown in agar 10 to 80 mm away from the seedling of *T. speltoides*.

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