SYNCHRONY OF TILLER DEVELOPMENT AND 2,4-D DAMAGE IN WHEAT

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Summary. The tolerance of wheat to 2,4-D varies with the stage of development of the head at the time of spraying. Varieties with different patterns of tiller development will be affected differently by the time of application of 2,4-D. Varieties with a more synchronous tiller pattern could be treated earlier.

A range of tiller development patterns was produced by sowing wheat cv. Condor at four seed rates (15 to 120 kg ha^{-1}). 2,4-D was sprayed on the crop at 5 stages, ranging from the 1 leaf stage to jointing stage. Damage from early application of 2,4-D caused a greater yield reducation at low seed rates than at high seed rates. At a given spray time the plants in the low seed rate have a greater proportion of less developed tillers which are susceptible to 2,4-D damage, than plants at high seed rates which have more synchronous tillering.

Wheat cultivars with a synchronous tillering pattern would be less affected by early spraying of 2,4-D than those with an asynchronous tillering pattern. If a farmer has a wheat crop with a wide range of tiller development stages resulting from environment, genotype or cultural practice, 2,4-D damage can be reduced by a delay in spraying.

INTRODUCTION

Wheat varieties differ in their tolerance to 2,4-D (Mitchel and Popay 1977; Smit and Youbert 1977). The tolerance of wheat to 2,4-D varies with the stage of development of the spike at the time of spraying (Myers 1953; Pinthus and Natowitz 1967; Shaw *et al.* 1955). Ear deformities are unlikely if the crop is sprayed after the spike primordia are fully differentiated. Within a wheat plant there is a range of tiller maturities. The ideal stage of application of 2,4-D for the main shoot will be too early for subsequent tillers (Nel *et al.* 1979; Friesen and Olsen 1953; Tottman and Duval 1978). Therefore, differences in tillering pattern of a variety will affect its tolerance to 2,4-D. Other factors such as patterns of translocation may also affect the tolerance of wheat to 2,4-D (Peterson 1958; Olunuga *et al.* 1977).

The aim of this trial was to examine the effect of tillering pattern on damage from 2,4-D.

MATERIALS AND METHODS

This field experiment was conducted at Wagga Wagga, New South Wales on a silty clay loam. To produce a range of tiller development patterns the wheat cultivar Condor was sown at four seed rates. This approach was chosen in preference to using a range of varieties with different tillering patterns to avoid confounding the results with other varietal differences. The trial was sown on

May 26 1980 with 9.12 kg P ha^{-1} (100 kg ha^{-1} single superphosphate). Seed rates used were 15, 30, 60 and 120 kg ha^{-1}. 2,4-D at 0.7 kg ha^{-1} was sprayed on the crop at five stages ranging from the one leaf stage to jointing stage. The spray was applied in 100 L ha^{-1} with a tractor-mounted compressed-air sprayer at 150 kPa. The experiment was a split-plot design with four replications; spray time treatments were the main plots and seed rates were the sub-plots. Plot size was 10 m by 9 rows. Crop establishment was measured 3½ weeks after sowing. Before harvest quadrats were taken to measure tiller numbers per plant, height, components of grain yield and to score herbicide damage to the crops. The trial was harvested in December 1980.

RESULTS AND DISCUSSION

A range of tiller development patterns was achieved by altering the seed rate. At the low seed rates each plant had a greater number of tillers per plant, with a wider range of tiller maturities than plants at the high seed rates, as shown in Table 1.

Table 1. The effect of seed rate on the pattern of tiller development of wheat eight weeks after sowing.

Seed rate (kg ha^{-1})	Emergence (plants m^{-1} row)	Heads at maturity (no./plant)	Stage of tiller development[1]					
			Tiller					
			Main	1st	2nd	3rd	4th	5th
15	6	7.1	5	4	4	3	2	1
30	11	5.5	5	4	3	3	2	-
60	21	3.6	5	4	3	3	-	-
120	41	2.5	5	4	4	-	-	-

[1] A scale (0 to 10) for assessing development stages of a wheat head (Nerson *et al.* 1980).

There was a significant interaction of seed rate by time of application on the grain yield. In the low seed rate plots, yields were reduced more by early spraying of 2,4-D compared with the high seed rate plots, as shown in Figure 1. This is related to the range of tiller development pattern of the plants at the different seed rates indicated in Table 1. At the early spray times (6½ and 8 weeks after sowing) the latest tillers in the low seed rate plots were still in a susceptible stage, hence yield was reduced. At later spray times these tillers had passed the susceptible stage and yield was unaffected.

The observed damage was related to the stage of development of the tillers at spraying. Application before head initiation resulted in onion leaf; this is usually the flag leaf but if 2,4-D is applied very early other leaves can be affected. This onion leaf can trap the emerging head causing a bent and twisted head. Also, at this early stage of application the growing point can be killed leading to tiller mortality, and a severe yield reduction (Shaw *et al.* 1955). At later stages of application the most common forms of damage were deformities in head development such as missing or paired spikelets.

Several conclusions have been drawn from this work. Firstly, plant breeders should select varieties with more synchronous tiller development patterns so that 2,4-D can be applied early to minimize weed competition. This

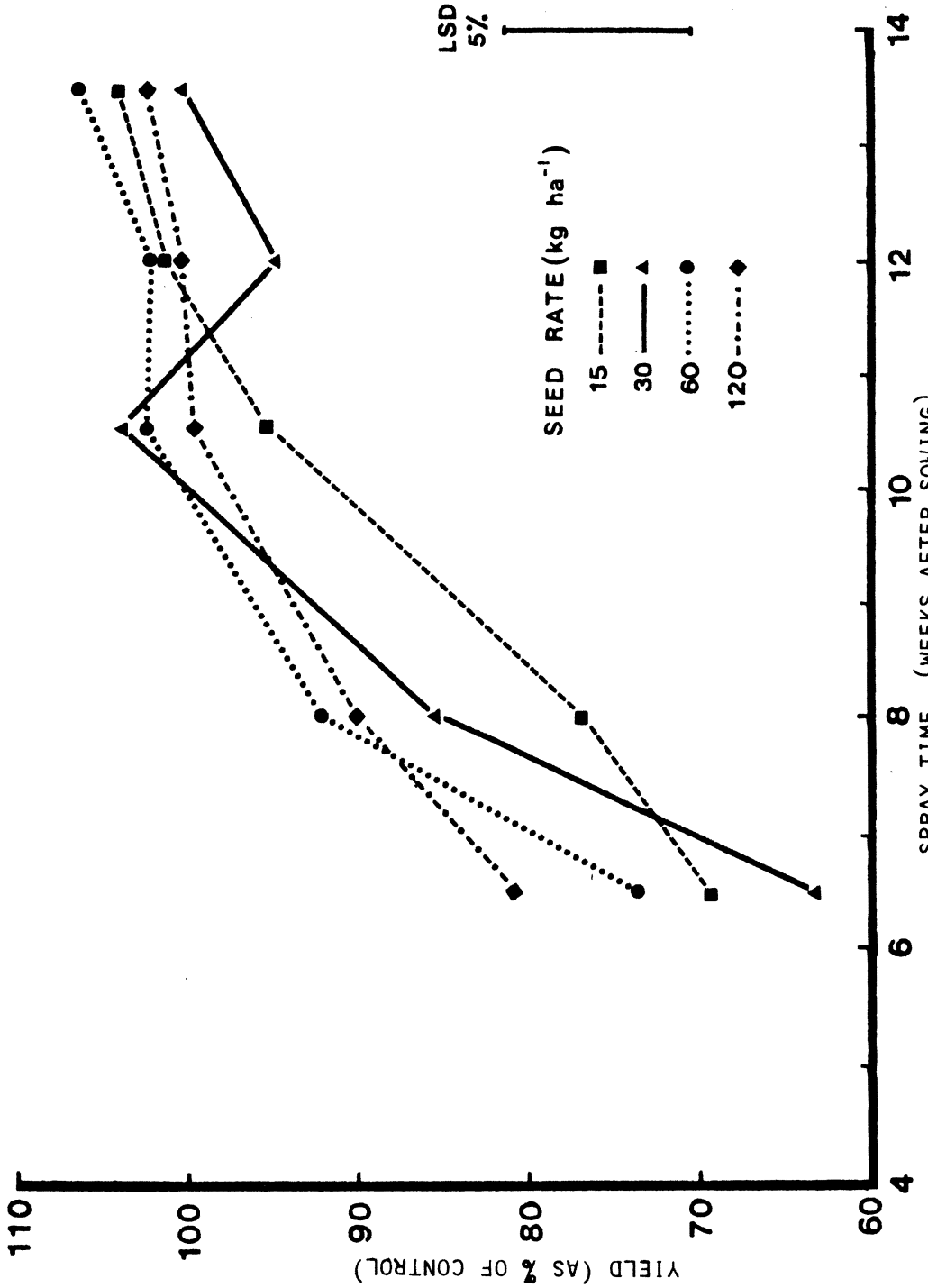

FIGURE 1. EFFECT OF TIME OF SPRAYING 2,4-D AND SEED RATE ON WHEAT YIELD

could be achieved by selecting varieties with less tillers, for example Donald's ideotype (Donald and Hamblin 1976). Secondly, farmers who know they will have to apply 2,4-D early could increase their seed rates to reduce risks. Thirdly, if a farmer has a crop, which due to environment or cultural practices has a wide range of tiller developments, he should delay spraying of 2,4-D. Lastly, any research undertaken in the future which examines the effects of herbicides on wheat varieties should consider the effect of seed rate on the response of the wheat to herbicides.

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