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N. H. CHAMBERLAIN

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EDITOR'S NOTE

The Cereal Rusts Bulletin should be an aid to the rapid dissemination of information, publication of interim results and any other topic of interest to cereal rust research workers. Rust diseases are ever present and there is always something new or different happening. The Bulletin can therefore be used to keep other rust workers informed.

All contributions to the Bulletin will be considered and copies should be sent to me at the following address:

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COMMENT

In spore production of Puccinia hordei in the glasshouse at NRPB using seedlings ,the production of both urediospores and teleutospores has been observed on the same leaves. This is the first time this has been seen in the glasshouse on seedlings. I would be pleased if anyone who has had similar observations could let me know, and if they have any reasons why it should happen.

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POSSIBLE CONTROL OF BROWN (LEAF) RUST ON WINTER WHEAT BY APPLYING CHLORIDES TO THE SOIL

BY

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ABSTRACT

Applications of certain chloride salts to the soil reduced the severity of brown (leaf) rust (Puccinia recondita Rob. ex Desm. f. sp. tritici) on seedling and adult winter wheat plants in a series of glasshouse experiments and one field trial. For example, lithium, sodium or potassium chlorides, applied to the soil surface at the rate of 0.5g of pure chemical per plant, seven days before inoculation with P. recondita, gave a particularly good control of brown rust. Foliar sprays of chloride salts did not significantly decrease brown rust.

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The level of plant nutrients in the soil can affect the severity of rust diseases of wheat. For example, many workers (e.g. Doak, 1931) have reported that wheat plants growing in soil with an excess of nitrogen are usually exceptionally susceptible to rusts and that an excess of phosphorus or potassium can decrease brown rust. More recently Russell (1978) has shown that soil applications of sodium or potassium chloride can give a partial control of yellow rust (Puccinia striiformis) in wheat. This report presents the results of preliminary experiments to investigate the effects of soil-applied chloride salts on brown rust (Puccinia recondita Rob. ex Desm. f. sp. tritici) in winter wheat.

The first seven experiments (Expts 1-7) were carried out in a spore-proofed glasshouse on plants of six winter wheat cultivars (Cappelle-Desprez, Bilbo, Maris Huntsman, Little Joss, Nord Desprez and Maris Widgeon) inoculated with P. recondita either as seedlings (growth stage 14) on the decimal scale of Zadoks, Chang and Konzak (1974) or as adult plants (growth stage 41). In each experiment, plants of each variety were allocated at random to one of the following treatments in a split-plot design: 1, no chemical added; 2, lithium chloride; 3, potassium chloride; 4, sodium chloride; 5, ammonium nitrate; 6, sodium phosphate. Analytical-grade chemicals were applied as a dry powder at the rate of 0.5 g/plant to the surface of the potting compost of each pot. The powder was watered in 1 week before the leaves were inoculated with uredospores of P.recondita (isolate 510/23 from the Plant Breeding Institute, Cambridge). The leaves were sprayed with distilled water using a hand-operated atomizer, before they were dusted uniformly with a mixture of 1 part uredospores to 1 part purified talc. The plants were then sealed in polyethylene bags to maintain high humidity around the inoculated leaves and the plants were then incubated at approximately 15°C for 48 hours. The severity of brown rust on each inoculated plant was assessed by eye about 3 weeks after inoculation using

the following 0-4 scale: 0 = no infection; 1 = very slight infection; 2 = slight infection; 3 = moderate infection; 4 = severe infection. The results of Expts 1-8 are given in Table 1. Interactions between cultivars and salt treatments were not significant in any experiment and the symptom scores in the Table are therefore given as means of six cultivars.

Differences between mean rust scores of different salt treatments were highly significant ($P < 0.001$ in Expts 1-6 and 8; $P < 0.01$ in Expt. 7), lithium chloride, potassium chloride and sodium chloride generally decreasing rust severity. Lithium chloride was phytotoxic at the concentration used, treated plants being stunted and chlorotic. Conversely, potassium chloride significantly decreased brown rust in each experiment without causing any visible adverse effects on treated plants. Ammonium nitrate, sodium phosphate and potassium nitrate had only small and inconsistent effects on brown rust.

In Expts 8-10, plants of the same six wheat cultivars were grown and inoculated at growth stage 14 as previously described. Sodium chloride or potassium chloride were applied to the potting compost at the following concentrations per plant: a, 0.2 g; b, 0.5 g; c, 1.0 g; d, 1.5 g, and watered in 7 days before inoculation with P.recondita. The plants were scored for severity of brown rust after 3 weeks, using a 0-4 scale. As in previous experiments both potassium and sodium chloride reduced brown rust severity. However, similar results were obtained with all three concentrations of both salts, suggesting that the amount of chloride applied is not critical in affecting brown rust.

In Expts 11 and 12, seedlings of cvs Maris Huntsman and Nord Desprez were treated with 0.5g of potassium chloride per plant, applied to the potting compost 3, 7, 10 or 14 days before inoculation with P.recondita, immediately before inoculation and 3 days after inoculation. All the pre-inoculation treatments with potassium chloride decreased brown rust to approximately the same extent but this salt did not decrease the disease when it was applied at or after inoculation. These results suggest that potassium chloride inhibits development of brown rust only in those plants that have already absorbed and translocated the salt.

The effects of soil applications and foliar sprays of potassium chloride, sodium chloride and lithium chloride on brown rust were compared in Expts 11 and 12. As with yellow rust (Russell, 1978), foliar sprays of chlorides did not affect brown rust, presumably because insufficient quantities of the salts were absorbed by the leaves, even when a wetter was added to the spray.

A small field experiment was planted at Close House, Wylam, Northumberland, in 1978 to investigate the effects of soil-applied potassium chloride, sodium chloride, potassium nitrate and sodium phosphate on brown rust in the field. The salts were applied as a dry powder to the soil of small plots comprising widely spaced plants (15 cm apart) of cvs Cappelle Desprez, Bilbo, Maris Huntsman, Little Joss, Nord Desprez and Maris Widgeon, at the rate of 1.2 g/plant (533 kg/ha) and were watered in. The plants were inoculated with P. recondita (race 61/37) after 10 days as described previously. Inoculated plots were immediately covered with large polyethylene bags for 48 hours to encourage high humidity for germination of P.recondita uredospores. The effects of the salt treatments were assessed by scoring each plot by eye using a

0-4 scale for severity of brown rust symptoms. As in the glasshouse, soil-applied potassium chloride decreased brown rust significantly ($P < 0.05$); sodium chloride also decreased the disease but not significantly (Table 1). Sodium phosphate and potassium nitrate did not affect the disease.

The results of these preliminary experiments suggest that, as with yellow rust (Russell, 1978), applications of certain chlorides to the soil can give some control of brown (leaf) rust in winter wheat. Similar results were obtained with several winter wheat cultivars: this suggests that chlorides may affect brown rust on many other cultivars. Although it is unlikely that salt applications by themselves would give an adequate control of cereal rusts, they might help to increase the effectiveness of other measures, such as the use of fungicides on resistant varieties.

During the course of these studies L O Hashim was supported by a scholarship from the Sudan Government. This work forms part of his MSc. thesis, submitted to the University of Newcastle upon Tyne.

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Table 1. Effects of soil applications of five chemicals on the severity of brown rust in winter wheat.

Chemical Treatment	Glasshouse experiment no. 1	2	3	4	5	5	7	8	Field Experiment
	Scores for severity of brown rust (means of six cultivars)								
Control (none)	2.0	2.2	2.7	2.6	2.8	2.7	2.6	2.5	1.5
Lithium chloride	1.0	1.5	1.5	1.3	2.2	2.0	2.2	1.7	-
Potassium chloride	1.3	1.1	2.0	1.5	1.7	1.8	2.1	1.8	0.8
Sodium chloride	1.3	1.6	2.2	2.1	2.5	2.1	2.0	2.2	1.2
Ammonium nitrate	2.0	3.0	3.0	-	2.8	2.4	2.7	1.8	-
Sodium phosphate	1.5	2.2	2.5	-	3.2	2.2	2.4	2.2	1.5
Potassium nitrate	-	-	-	2.5	-	-	-	-	1.7
S.E.D.	± 0.2	±0.2	±0.1	±0.4	±0.3	±0.2	±0.2	±0.2	±0.3
L.S.D. (P<0.05)	0.5	0.5	0.3	0.8	0.6	0.5	0.5	0.5	0.6
Growth stage of plants at inoculation	14	14	14	14	41	41	41	41	41

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STRIPE RUST (PUCCINIA STRIIFORMIS), A NEW DISEASE OF WHEAT IN NEW ZEALAND

BY

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Stripe rust was discovered on wheat in New Zealand about one year after its appearance in south-eastern Australia (O'Brien et al 1980). Whereas it is thought to have been brought to Australia from Europe by human agencies, its spread to New Zealand was probably by air-borne urediniospores carried across the Tasman Sea by east-moving weather systems. This mode of spread from Australia to New Zealand is well documented for other rusts (Close et al. 1978). Stripe rust was first found in the Southland district (figure 1) in November 1980 (late spring), and although it spread throughout Southland that season, losses were minimised by the use of foliar fungicide sprays. In January 1981 (mid-summer) it was found at Lincoln in Canterbury. However, crops in that district were not severely affected until the following season. In August 1981 (late winter) wide-spread infection was found in autumn-sown wheat in Canterbury, and in November 1981 it was again found in spring sown wheat in Southland, and also in the Manawatu district.

Wheat Production in New Zealand

New Zealand's annual wheat production is about 350,000 tonnes. The main wheat growing areas are: Canterbury (60%); Southland (20%); Otago (13%); Manawatu and Wairarape (6%). In Canterbury and

North Otago most wheat is autumn-sown (sown May-June, harvested February-March), whereas in South Otago, Southland and the North Island, it is spring sown (sown October-November, harvested March-April). Wheat yields in Canterbury average 2.5-3.5 tonnes per hectare, in Otago 3-4 tonnes per hectare and in Southland and the North Island 4-5 tonnes per hectare.

Stripe Rust Susceptibility of New Zealand Cultivars

Table 1 lists the most widely grown New Zealand wheat cultivars, showing their susceptibility to stripe rust, and the main districts where each is grown.

Table 1: Susceptibility to stripe rust of the main New Zealand cultivars.

Cultivar	Seedling reaction	Percent leaf area affected at anthesis*	Main growing district
Tiritea	Highly susceptible	80-100	Southland: S Otago
Takahe	Moderately "	40-70	Southland: S Otago
Rongotea	Moderately "	40-60	Canterbury: N Otago
Kopara	Moderately "	10-30	Canterbury: Otago & Southland
Karamu	Highly resistant	0-5	North Island

* Range of stripe rust severity in unsprayed plots of 7 fungicide control trials in Canterbury and Southland during 1981.

Replicated plot trials conducted during the 1981/82 growing season showed that without fungicide protection Tiritea suffered up to 60% yield loss due to stripe rust infection, and that Rongotea and Takahe suffered 20-30% loss. Kopara suffered a yield loss only under conditions of high infection pressure, and Karamu was not affected.

It appears that in the immediate future farmers are prepared to continue growing the same cultivars, and will rely on fungicide protection to prevent losses due to stripe rust. Wheat breeders in New Zealand are evaluating material for stripe rust resistance of a race non-specific nature, but the time required for evaluation before new cultivars can be released means that it could be 2-3 years before resistant material is widely grown.

Stripe Rust Races in New Zealand

The race of stripe rust in New Zealand has been identified from isolates collected during the 1980/81 season as 104 E137, which was the first race found in 1979 (Wellings and McIntosh 1982). Race 104 E137 was also identified from the barley cultivar Magnum which was found to be infected with stripe rust at the seedling stage in Canterbury in spring 1981. The disease was not an economic problem in barley.

Epidemiology in Canterbury and Southland

Figure 2 is a summary of rainfall, temperature, and stripe rust epidemics in Canterbury and Southland during the 1981/82 growing season.

In Canterbury, autumn-sown wheat emerges in June, but growth of the plants is almost static throughout the cold months of July and August. However, in late July 1981 stripe rust was found to be present in some of the May sown crops, which suggests that winter temperatures were high enough to permit activity of P.striiformis. The unusually warm June may have been important in the appearance of infection in crops during July. Very little increase in disease prevalence occurred during August. In mid-September the disease first became noticeable to farmers and widespread fungicide spraying began. From mid-October loss of leaf area due to stripe rust was apparent in susceptible cultivars.

In Southland, rising temperatures after spring sowing mean that when plants emerge they grow rapidly. In contrast to the Canterbury epidemic where disease increased immediately after primary infection. Infection was first noticed by Southland farmers in mid-November 1981 and loss of leaf area was apparent from early December.

In both districts, carry over of stripe rust between crops appears to be on volunteer wheat plants. In Canterbury the wheat stubble from the previous season may be burnt after harvest, or the self sown plants may be grazed by sheep. However, sporulating stripe rust could readily be found on remaining volunteers during June 1981 when the new season's crops were emerging. In Southland, stripe rust has to survive for a longer period in the absence of a wheat crop, but volunteer plants tend to remain undisturbed throughout the winter.

Stripe Rust Control with Fungicides

About 20 replicated trials were carried out in Canterbury and Southland by DSIR, MAF, universities and agricultural chemical companies during the 1981/82 season to investigate the use of fungicides for stripe rust control. These generally showed that two foliar applications gave economic yield increases in susceptible cultivars. In some areas with high yield potential, particularly in Southland and under irrigation in Canterbury, a third application was profitable. The only fungicide registered by the N. Z. Agricultural Chemicals Board for foliar application to control stripe rust during the 1981/82 season was Bayleton (triadimefon), but several other products are under evaluation.

Fungicide seed treatment was also investigated. Baytan (triadimenol and fuberidazole), while not always giving a yield increase in plot trials, did give a reduction in severity of leaf infection up to the time of ear emergence.

DISCUSSION

The cost of controlling stripe rust in New Zealand has been met by the wheat growers through the purchase of fungicides. This has reduced the profitability of wheat growing, and could affect the area sown in wheat in future years.

The widespread use of fungicides to control stripe rust has also controlled the other main foliar diseases of wheat in New Zealand (speckled leaf blotch, leaf rust and powdery mildew). These could become a problem again if fungicide use diminishes with the introduction of stripe rust resistant cultivars.

Low temperatures are reported to be optimal for many phases of the infection cycle of Puccinia striiformis (Rapilly 1979). In this light stripe rust was initially expected to be less of a problem in Canterbury, with its warm dry summer, than in the cool wet climate of Southland. The disease was however a severe problem in both districts in the 1981/82 growing seasos. It remains to be seen whether or not this will always be the case.

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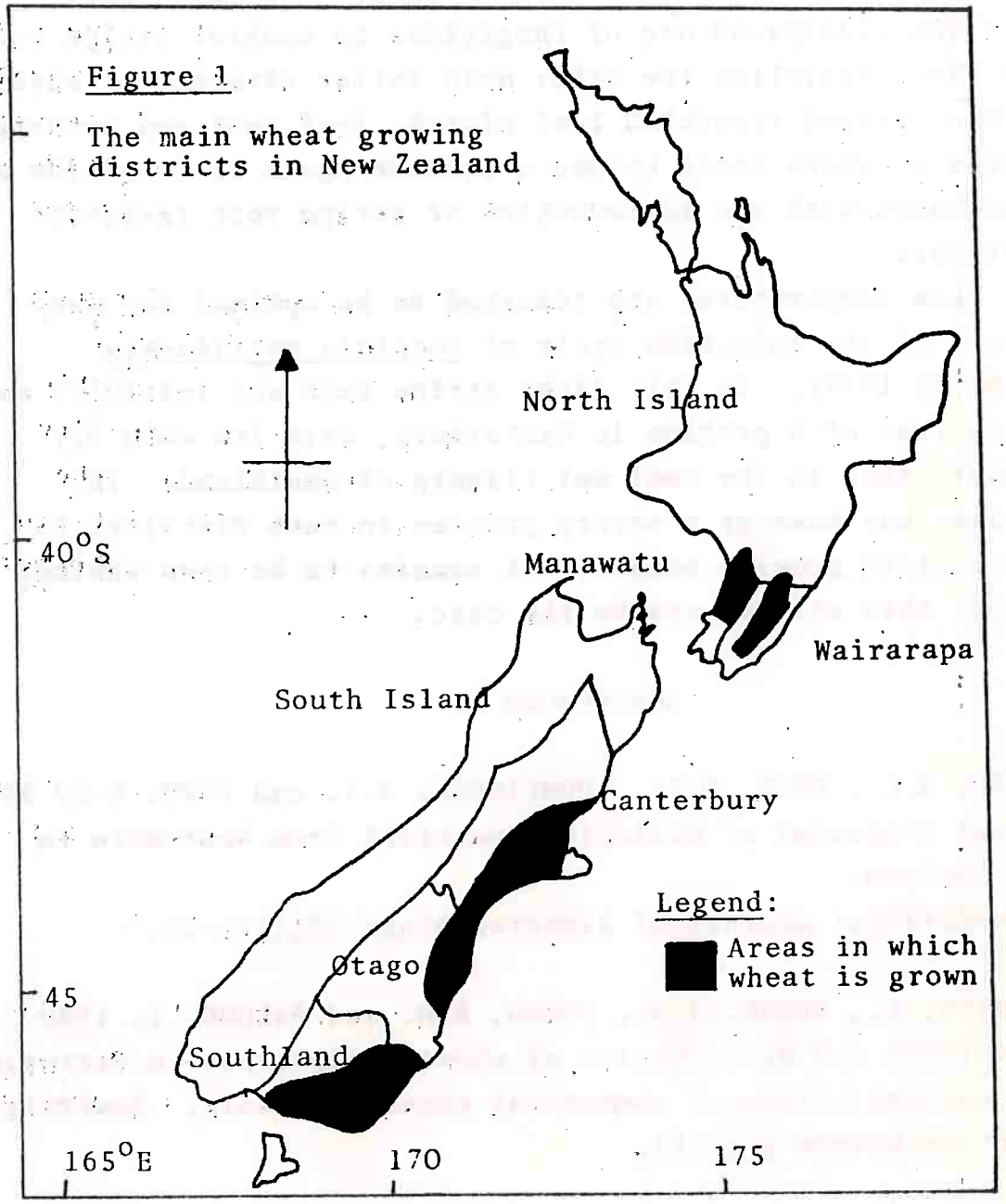


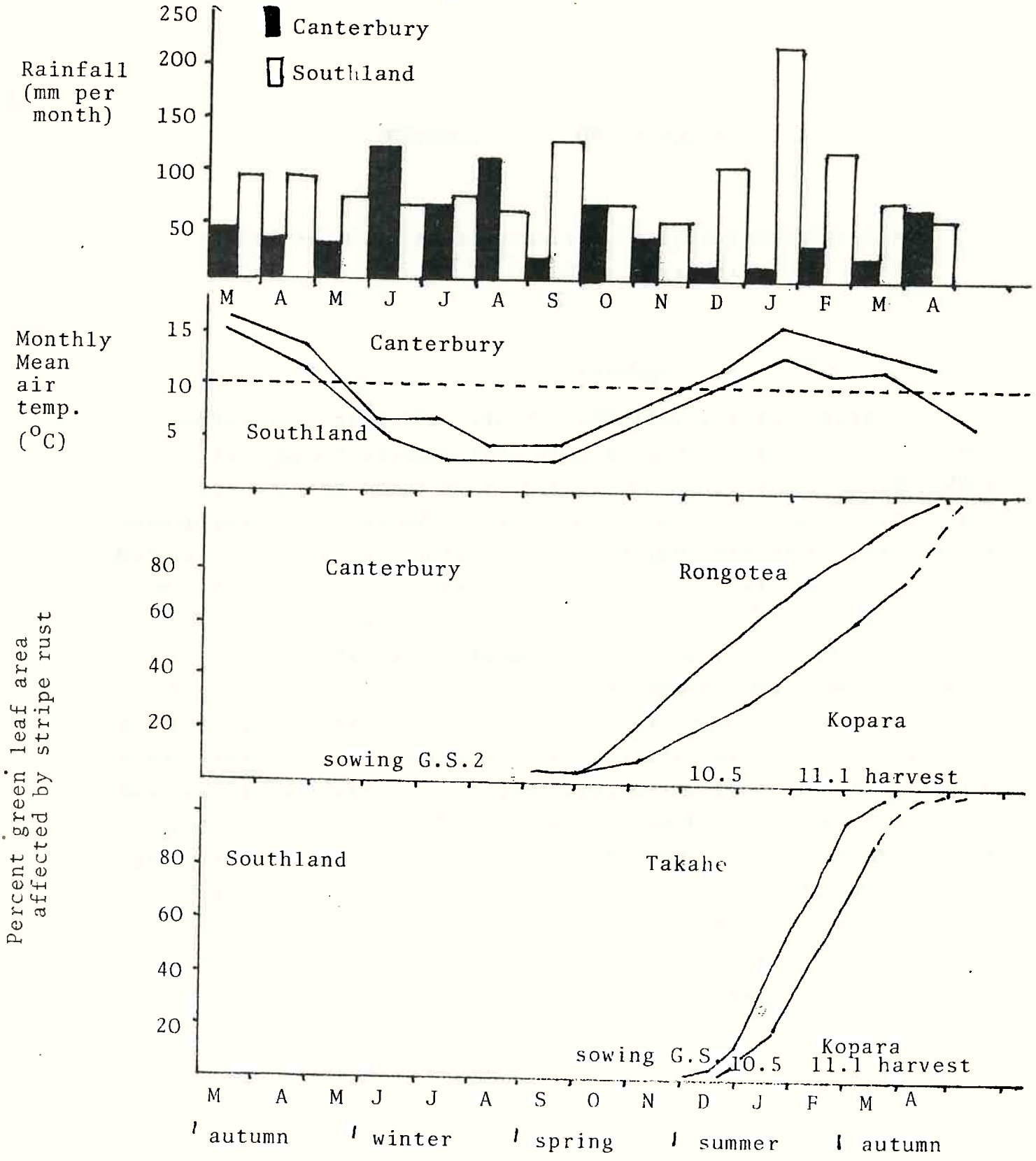
Figure 1
The main wheat growing districts in New Zealand
North Island
40°S
Manawatu
Wairarapa
South Island
Canterbury
Legend:
Areas in which wheat is grown
Otago
45
Southland
165°E
170
175

Figure 2: Rainfall, temperature and stripe rust on wheat in Canterbury and Southland during the 1981/82 growing season. Disease progress curves are derived from field plots with early infection and no fungicide control.

_____ leaf area loss attributed to stripe rust infection

---------- leaf area loss partially due to natural senescence.

G.S. = Feekes Growth Stage.



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THE DEVELOPMENT OF BARLEY YELLOW RUST (PUCCINIA STRIIFORMIS) ON DIFFERENT CULTIVARS IN RELATION TO PRE- AND POST- INOCULATION TEMPERATURE

BY

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SUMMARY

In studies on the influence of pre- and post-inoculation temperatures on barley yellow rust development, incompatible combinations of isolate and cultivar were found to give very restricted or no colony development with the various temperature treatments. With the compatible combination of Astrix inoculated with a BYVI isolate of Puccinia striiformis, a pre-inoculation temperature of 18°C, as opposed to 12°C, gave substantially larger and denser colonies on plants incubated at 14°C. In a separate study, when plants were incubated at either 14 or 18°C, a pre-inoculation temperature of 14°C, rather than 18°C, resulted in larger colonies on Astrix. In this study Zephyr showed little response to pre-inoculation temperature: in comparing the two cultivars Astrix was found to be more susceptible, as evidenced by more rapid colony development, but usually only at the lower pre-inoculation temperature. At a post-inoculation temperature of 14°C there was extensive colony development in both cultivars, but colony sizes were on average significantly larger on Astrix compared with Zephyr.

INTRODUCTION

Temperature has an important influence on the development of yellow rust (Puccinia striiformis West), and the disease is associated generally with cool climates. In certain cultivars, however, temperature mediated responses to infection have been observed and the expression of resistance or susceptibility is conditioned by the particular temperature regime before and after inoculation. These observations have usually been made with wheat yellow rust. Four types of response were described by Sharp (1965): cultivars remained resistant or susceptible at all temperatures or increased in resistance or susceptibility as temperature increased. These four categories were also recognised by Chamberlain and Doodson (1972) when they exposed 48 wheat cultivars to four diurnal temperature treatments. Beaver and Powelson (1969) reported that some wheat cultivars were resistant at diurnal temperatures of 2/18^{o}C but susceptible at a constant 18^{o}C, while other cultivars, with some races, were more susceptible at the varying diurnal temperature regime. Cultivars possessing minor genes for resistance have been shown to give different infection types when exposed to a constant temperature as opposed to diurnal temperature fluctuations: Brown and Sharp (1969) found that the wheat cultivar Rego gave a resistant infection type in constant high or low temperature but a susceptible reaction after diurnal temperature fluctuations. These workers also reported that cultivars showed significant changes in infection response following only a few hours temperature change and suggested that factors formed before inoculation may subsequently affect the host-pathogen reaction. Such factors may involve proteins of the host: Strobel and Sharp (1965) have shown that extra proteins were present in two wheat cultivars grown at 15^{o}C night/24^{o}C day, when they gave a susceptible reaction, compared with their growth at 2^{o}C night/18^{o}C Day, when they gave a resistant infection type. No changes in protein associated with different temperature treatments were found in cultivars which remained resistant or susceptible throughout. In this paper a report is given of two experiments to investigate any temperature effects on the pre-disposition of barley cultivars

to infection by Puccinia striiformis.

MATERIALS AND METHODS

In the first experiment barley plants, cv. Astrix, with resistance factor BYRI (Priestly and Byford, 1979) were grown up to the fourth leaf stage at either 12 or 18°C. Two types of cabinets were used for each temperature, one with a light intensity of 10,000 lux (16 h day) and with 80% RH and the other with a light intensity of 3,4000 lux (16 h day) and approximately 55% RH. Using modified forceps (Priestly and Doling, 1972), three leaves, excluding the seedling leaf, were point inculated in the centre of the adaxial surface with a spore/talc mixture of an isolate of Puccinia striiformis with Astrix virulence, BYVI (Priestly and Byford, 1979). Plants were incubated for 48 h at 10°C in a saturated atmosphere and then returned to cabinets at 14°C, 80% RH and a light intensity of 10,000 lux (16 h day). After the onset of yellow rust symptoms, colony size and the number of actively sporulating pustules 2 cm^{2-1} were recorded at 3-5 day intervals. From additional plants at the time of inoculation, basal and distal leaf segments were cut from the three leaf positions. The segments were placed on benzimidazole water agar (80 ppm) and inoculated with spores in a settling tower. After 24 h incubations at 10°C the leaf segments were cleared with chlorine, strained with trypan blue and examined for spore germination and appressorium formation. In addition, values were assigned on a scale of 0-5 to the extent of the surface growth of germ tubes.

In a second investigation plants of Astrix and Zephyr, (resistance factor BYR1), and Mazurka and Varunda, with resistance factor BYR2 (Priestly and Byford, 1979), were grown for 21 days at temperatures of either 14 or 18°C (80% RH, 16 h photoperiod of 10,000 lux). After this time the top two leaves on plants grown at 14°C (GS 21) and the top four leaves of plants grown at 18°C (GS 23) were point inoculated as already described with a BYV1 isolate of Puccinia striiformis. After incubation at 10°C for 48 h the plants were returned

to either their pre-inoculation temperature or the alternative temperature regime. At 14 days and thereafter 4-5 day intervals measurements were taken of colony sizes.

RESULTS

From the results of the first experiment, the temperature at which plants were grown prior to inoculation was found to affect significantly both colony size and pustule number: plants grown at 18°C had much larger and denser colonies than those grown at 12°C (Table 1). It may be seen from Table 1 that the rate of pustule formation started to decline after 23 days, before the decline in colony growth rate: it was observed that pustules towards the colony centre became inactive before those at the edge. Leaf position did not significantly affect either pustule number or colony size. There was, however, a significant block effect associated with cabinet: plants from cabinets at the higher light intensity and humidity before inoculation showed less fungal development. This effect was thought to be associated with the different light intensities but further investigations failed to confirm this as the contributory factor.

From microscopic examination of the leaf segments germination rates of spores were found to be slightly higher on plants grown at 12°C than on those grown at 18°C, but this was significant only with the distal segments of the second true leaves (Table 2). The percentage of sporelings with appressoria was not significantly affected by pre-inoculation temperature, but on distal segments it was observed that older leaves gave more spores in this category (Table 2). Germ tubes tended to be longer on plants from the lower pre-inoculation temperature but this effect was significant only with results from the distal segments.

From the second experiment, carried out with four cultivars, the general effects of pre- and post-inoculation temperature are presented in Table 3. Pre-inoculation temperature had a significant effect on colony development after 14 and 18 days, colonies

being larger on plants which had been grown at 14°C. Thereafter the influence of pre-inoculation temperature declined and at the later stages the post-inoculation temperature exerted a major influence, plants kept at 14°C after inoculation giving significantly larger colonies. In general, colonies tended to be larger on the younger leaves. There was no interaction between the effects of pre- and post-inoculation temperatures but significant interactions were evident between temperature treatments and cultivar. Colony sizes on Astrix and Zephyr were always significantly greater than those on Mazurka and Varunda: these cultivars showed either delayed and limited colony development or an absence of symptoms particularly at the post-inoculation temperature of 18°C (Table 4). In comparing Astrix and Zephyr and the effects of pre-inoculation temperature, it may be seen that while colony sizes were on average larger on Astrix than on Zephyr, they were only consistently and significantly greater where plants had been grown at a temperature of 14°C. At the higher pre-inoculation temperature the larger colony size associated with Astrix was evident only in the later stages of colonisation, when it was also noted that colony size diminished rapidly on Zephyr plants previously grown at the high temperature. In considering Astrix and Zephyr in relation to post-inoculation temperature, the larger colony size associated with Astrix was evident usually at 14°C but not at 18°C (Table 4).

DISCUSSION

The results of the two experiments indicate that although the development of barley yellow rust is regulated by the particular combination of host and pathogen genotype, the expression of compatible responses may be consistently modified by the temperature at which plants are grown before or after inoculation. With the compatible host-pathogen combination, Astrix - BYVI, it was found that pre-inoculation temperature had a significant effect on subsequent colony development. In one study, colony size was larger with a temperature of 18°C as opposed to 12°C before inoculation and, in a second experiment a pre-inoculation temperature of 14°C compared with 18°C gave larger colonies, more especially during the early stages of disease development. In this second investigation Zephyr, which has the same resis-

tance factor (BYR1) as Astrix, appeared less suscepible to a compatible isolate. Pre-inoculation temperature had little effect on colony development in Zephyr, apart from a rapid decline in colony size during the advanced stages of the disease on plants grown at 18°C. In comparing Astrix and Zephyr grown at 14 or 18°C before inoculation, the larger colony size associated with Astrix was evident during the earlier stages of colony development, only with plants grown at 14°C. With incompatible host-pathogen responses, as exemplified by Mazurka and Varunda (BYR2) and an isolate with virulence BYV1, colony development was limited irrespective of pre-inoculation temperature. The influence of post-inoculation temperature became most evident during the later stages of colony development on Astrix and Zephyr: a temperature of 14°C gave much larger and more persistent colonies than a temperature of 18°C. The larger colony sizes on Astrix as compared with Zephyr were found only at the lower temperature: at 18°C both cultivars showed small colonies of limited duration. With incompatible combinations, colony development at 14°C was very restricted and infection failed to become established at 18°C.

The optimum temperature for wheat yellow rust development has been given as 11°C (Butler and Jones, 1949) and 13-16°C (Newton and Johnson, 1936). Macer (1975) has suggested that there may be some changing genotype of P striiformis which is more tolerant of higher temperatures. These reports presumably relate mainly to the effects of temperature on infection processes. Studies, however, have indicated that the pre-inoculation temperature might influence the predisposition of the host to infection, although in many of these the pre-inoculation effects are often confounded with incubation effects (Beaver and Powelson, 1969; Chamberlain and Doodson, 1979; Sharp, 1965). In some of this work temperature insensitive cultivars have been identified as well as cultivars which show increased resistance or susceptibility with increasing temperature. With higher incubation temperatures, however, the reduced infection may relate to the sensitivity of the pathogen rather than the increased resistance of the host. For example, Vanderplank (1978) points out that in work by Gassner and Straib (1934), in which a change from susceptibility to resistance in

wheat was attributed to an increase in mean temperature from 14.8 to 24.3°C, the higher temperatures used were in fact at or above the maximum for spore germination. However, some cultivars were still susceptible at the highest temperature. Moreover, in the work of Chamberlain and Doodson (1972), some cultivars were still susceptible at a temperature regime of 15°C dark/30°C light while others were resistant. In their work, as in the present work, inoculated plants were subjected to a preliminary incubation period at low temperature to encourage the establishment of infection. In the present studies pre-inoculation temperature as distinct from incubation temperature, was seen to have a predisposing effect on infection of certain barley cultivars to infection by a compatible isolate of P. striiformis. The results suggest that a pre-inoculation temperature of 14°C as opposed to 18°C or 12°C favoured subsequent colony development. This effect was associated with events after fungal penetration. It is not possible to identify the precise nature of the effect, but other work has pointed to temperature mediated responses involving protein changes in the host (Strobel and Sharp, 1965).

Table 1 - The effect of pre-inoculation temperature on colony size and numbers of pustules of Puccinia striiformis (BYV1) on seedling plants of the barley cultivar Astrix. (Mean of first three true leaves).

Days after inoculation	Pre-inoculation temperature (°C)					
	12	18	SED (DF=15)	12	18	SED (DF=15)
	Colony size (mm)			Pustule no. 2 cm^{2-1}		
16	0.9	15.1	7.4	5.5	33.0	18.4
21	5.2	27.4	8.7	7.7	41.0	14.5
23	7.2	34.4	9.3	10.6	46.0	12.5
27	7.9	45.2	11.6	8.3	36.9	10.1
30	9.5	44.5	10.1	8.9	31.6	7.7

Table 2 - Germ tube development from spores of Puccinia striiformis (BYV1) on leaves of the barley cultivar Astrix, in relation to pre-inoculation temperature.

Pre-inoculation temperature (°C)	Basal segments Leaf position 1	2	3	$\bar{x}$	Distal segments Leaf position 1	2	3	$\bar{x}$
	Germination percentage (transformed data)							
12	44.7	43.7	45.1	44.5	43.4	43.5	43.2	43.4
18	40.6	42.6	39.8	41.0	36.0	34.2	37.9	36.0
SED (DF=55)		± 3.6		±2.1		±3.8		±2.2
	Percentage germinated spores with appressoria (transformed data)							
12	1.7	3.1	2.7	2.5	0.6	6.1	4.4	3.7
18	4.7	2.0	2.9	3.2	0.4	5.9	2.5	2.9
SED (DF=55)		±1.4		±0.8		±1.1		±0.7

Table 3 Effect of two pre- and post-inoculation temperatures on colony size (mm) in Astrix, Mazurka, Varunda and Zephyr inoculated with Puccinia striiformis (BYVI) (mean of all leaf positions).

Days	Temperature				
	Pre-inoculation		Post-inoculation		SED
	18	14	18	14	
14	0.6	2.7	1.5	1.9	0.3 (131)
18	2.0	5.0	2.8	4.2	0.7 (130)
22	5.8	7.4	3.8	9.4	1.0 (129)
27	9.0	8.7	1.1	16.7	1.1 (130)
32	6.8	9.1	0.3	15.6	1.6 (130)

Table 4 Colony size (mm) on barley plants inoculated with *Puccinia striiformis* (BYVI) in relation to cultivar and pre- and post-inoculation temperature.

Temperature (°C)	Cultivar Astrix	Mazurka	Varunda	Zephyr	SED (DF)
Pre-inoculation	**14 days after inoculation**				
18	1.1	0.0	0.0	1.4	± 0.7
14	7.7	0.0	0.0	3.2	(131)
	18 days after inoculation				
18	4.0	0.0	0.0	4.1	± 1.5
14	14.8	0.0	0.0	5.3	(130)
	22 days after inoculation				
18	11.7	0.1	0.0	11.5	± 2.1
14	18.3	0.0	0.0	11.1	(129)
	27 days after inoculation				
18	19.9	0.9	0.1	15.2	± 2.2
14	21.0	0.0	1.1	12.8	(130)
	32 days after inoculation				
18	18.0	2.4	0.1	6.6	± 3.2
14	18.5	1.6	1.4	15.0	(130)
Post-inoculation	**14 days after inoculation**				
18	3.8	0.0	0.0	2.1	± 0.7
14	5.0	0.0	0.0	2.5	(131)
	18 days after inoculation				
18	7.3	0.0	0.0	3.9	± 1.5
14	11.5	0.0	0.0	5.4	(130)
	22 days after inoculation				
18	8.0	0.0	0.0	7.2	± 2.1
14	22.1	0.1	0.0	15.4	(129)
	27 days after inoculation				
18	1.7	0.6	0.0	2.6	± 2.2
14	39.2	0.9	1.2	25.4	(130)
	32 days after inoculation				
18	0.6	0.0	0.0	0.5	± 3.2
14	35.8	4.0	1.5	21.2	(130)

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Obituary

On the death of Dr. Eva Fuchs, Biologische Bundesanstalt fur Land- und Forstwirtschaft, Braunschweig, Germany.

After severe illness Dr. Eva Fuchs died on October 16, 1982 only a few days before her 60th birthday.

After her studies in biology, chemistry and physics at Konigsberg, Dr. Fuchs took her doctorale under Prof. Dr. Gassner at Braunschweig in 1952 and had been engaged since as a scientist in research into resistance and in resistance breeding at the Biologische Bundesanstalt fur Land und Forstwirschaft at Braunschweig. She continued Gassner's and Hassebrauk's investigations, and her researches into physiological specialisation of yellow rust have been internationally recognised. Appointed a member of many committees Dr. Fuchs was not only an excellent organiser and distinguished herself by her profound special knowledge, but thanks to her human values she was in a rare manner skilled in establishing contacts and connections among colleagues, which are of lasting value for all concerned.

Dr. Fuchs was chairman of the European and Mediterranean Cereal Rusts Foundation in the years 1972-1980 and essentially contributed to the development of this organisation. During her chairmanship two international Cereal Rusts conferences took place, at Interlaken, Switzerland, in 1976 and at Bari, Italy, in 1980.

A large number of friends among the big rust family mourn Dr. Fuch's untimely death. Her professional integrity, her human warmth and selfless dedication for the benefit of the cereal rusts investigation shall be an example and guideline to friends and colleagues.

Dr. A. Bronnimann, Chairman
of the European and
Mediterranean Cereal Rusts
Foundation

9 November 1982