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**FLAG SMUT RESISTANCE IN SELECTED
WHEAT CULTIVARS AND LINES**

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SUMMARY

Thirteen wheat cultivars and breeders' lines were evaluated in the field at Toowoomba for resistance to flag smut (*Urocystis agropyri*). The cultivars Spica, Kite and Gatcher proved highly resistant while Hopps, Songlen, Oxley, Timgalen, Cook and Timson had good levels of resistance. Gamut, Mendos and Tarsa, however were very susceptible.

I. INTRODUCTION

Flag smut (*Urocystis agropyri* (Preuss) Schröt.) is no longer regarded as a major disease of wheat in Australia yet 50 years ago it posed a serious threat to the industry. In the mid 1920's all the popular cultivars were susceptible to the disease and considerable losses were sustained (Macindoe and Walkden Brown 1968). In New South Wales losses of 10 to 15% were common with individual crop losses as high as 70% (Anon. 1970). Carne (1974) estimated a loss of about 22 000 tonnes in Western Australia during 1923 while Cass Smith (1954) indicated that 10 to 15% losses were common for that State in the 1920's. Brittlebank (1920) stated that flag smut was annually taking a toll of from 5 to 70% in Victoria and was by far the most important disease of wheat. Although seed treatments were used, the chemicals proved ineffective against soil-borne inoculum. The only logical means of control was host resistance.

In 1922 the Western Australian cultivar, Nabawa, was found to be highly resistant to the disease (Macindoe and Walkden Brown 1968) and within a decade it became the leading cultivar in most States. The popular acceptance of Nabawa, reinforced by the release of other resistant hybrids was responsible for a rapid decline in flag smut incidence. Within 20 years the disease was rarely seen.

The widespread cultivation of the Gabo-type wheats initiated a resurgence of the flag smut problem. Gabo, Mengavi, Gamenya, Mendos and Gamut were all susceptible to the disease and were widely grown in the north-eastern hard wheat areas of Australia. Losses of 10 to 15% were again commonplace (Anon. 1970). A potentially dangerous situation was averted by the release of Timgalen in 1967. It possessed a good level of resistance and has since been followed by the release of other resistant cultivars.

It is important that the conditions responsible for the heavy losses from flag smut in the 1920's and 1960's are not allowed to recur by ensuring that large areas within any region are not sown to susceptible cultivars for an extended period. Resistant cultivars should be available to the grower at all times. The work reported here was undertaken to examine the levels of resistance to flag smut in selected wheat cultivars and promising lines using isolates of the pathogen collected in southern Queensland.

II. MATERIALS AND METHODS

Experiments were conducted in 1974 and 1975. A randomised block design was used where each cultivar was planted as a single row either 3-m (1974) or 3·7-m (1975) long. The cultivars and lines used are listed in table 1. Federation was included as a susceptible reference.

Wheat plants affected with flag smut were collected from three field locations (Bowenville, Inglewood and Toowoomba) and ground to provide suitable inoculum. Seed of each cultivar or line was shaken with excess inoculum and hand planted at a depth of about 10 cm.

After flowering, counts were made to determine the proportion of plants with symptoms of the disease in each plot (incidence) and the proportion of diseased tillers on diseased plants (severity).

III. RESULTS

The incidence and severity of flag smut for each cultivar or line in each season are given in table 1. Kite, Spica and Gatcher were very resistant to the disease while Federation, Mendos, Gamut, and Tarsa were very susceptible. The other cultivars showed intermediate levels of resistance. There was a strong positive correlation between incidence and severity ($P < 0.01$) in both trials. This was obvious in the field where the susceptible lines had a much greater proportion of major tillers diseased than the more resistant ones.

TABLE 1
INCIDENCE AND SEVERITY OF FLAG SMUT IN SELECTED WHEAT CULTIVARS AND LINES

Cultivar	Incidence (%)		Severity (%)	
	1974	1975	1974	1975
Federation	77.7 a*	38.8 bc	90.2 a	78.0 a
Mendos	78.5 a	54.2 a	61.5 b	51.1 b
Gamut	63.4 b	34.9 c	54.7 bc	41.9 b
Tarsa	54.0 b	49.2 ab	68.9 ab	55.9 b
Timson	24.1 c	9.3 d	28.0 cde	35.6 bcd
Cook	23.5 c	2.2 efg	44.9 bcd	15.6 efg
Timgalen	22.4 c	4.4 de	27.4 cde	21.5 cdef
Oxley	15.6 c	4.3 def	21.1 de	18.6 def
Songlen	4.4 de	27.9 cde
UQ164	5.4 d	18.9 def
WW15	4.2 d	0.2 gh	15.6 ef	2.4 hi
Hopps	2.1 de	0.6 fgh	14.2 ef	7.1 fgh
UQ7410	0.2 gh	3.0 ghi
Gatcher	0.1 ef	0 h	2.4 fg	0 i
Kite	0 f	0 h	0 g	0 i
Spica	0 f	0 h	0 g	0 i

* The arcsin transformation was applied to all data for analysis. Percentages shown are equivalent means. Values in each column not followed by the same letter differ ($P < 0.05$).

IV. DISCUSSION

Valuable levels of resistance to flag smut are present in most of the wheat cultivars currently or recently grown in Queensland. In particular Kite, Spica and Gather are highly resistant. The resistance in Hopps and the lines UQ7410, WW15 and UQ164 is also very effective. Although Songlen, Oxley, Timgalen, Cook and Timson possess a lower level of resistance, this has been proven adequate by the success of Timgalen in areas where flag smut was becoming a problem at the time of its release. Also the cultivars would be expected to perform better in the field where inoculum pressure would not be as high as in these trials.

The susceptibility of Tarsa is of interest as the cultivar has been classed as resistant elsewhere (Walkden Brown and Fitzsimmons 1971; Matheson 1972; Ferns *et al.* 1975). Although little is known of biological specialization of flag smut in Australia (Cass Smith 1954; Watson 1958) it is possible that a different race of the pathogen was employed in the current examination from that used by other workers. If this is so, further testing of breeding material should be carried out with inoculum from various locations.

Host resistance has been very effective in controlling this potentially damaging disease. The resistance has remained effective since its initial introduction more than 50 years ago and there is little evidence of change in the pathogen for increased virulence. The current policy of ensuring that most cultivars possess adequate resistance to flag smut should be continued. It seems unnecessary to stipulate that all cultivars for this area be resistant to flag smut provided growers are made aware of the levels of resistance in recommended cultivars.

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