

QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

DIVISION OF PLANT INDUSTRY BULLETIN No. 367

SOME FIELD OBSERVATIONS ON CROWN ROT  
DISEASE OF WHEAT CAUSED BY FUSARIUM  
GRAMINEARUM

By T. MCKNIGHT, M.Sc., Ph.D., and J. HART, Q.D.A.

SUMMARY

The disease is more severe on heavier soils and in lowlying and depressed areas of plantings; it appears to be less severe in crops following a long fallow and when rotations to resistant crops have been carried out. Seed treatment appears to have no effect on yield in badly infested soils.

Varieties with a relatively low incidence of deadheads include Gala, Lawrence, Gabo, Cailloux and Puglu.

I. INTRODUCTION

A serious crown rot disease of wheat in Queensland is caused by the fungus *Fusarium graminearum* Schw., the conidial stage of *Gibberella zeae* (Schw.) Petch. Elsewhere in the world the perfect stage of this fungus is associated with a "scabbed" head condition in wheat. This stage was not detected by the authors in Queensland on wheat plants during the course of these observations but it was subsequently recorded by G. S. Purss in 1964 (personal communication).

While the first record of this fungus causing crown rot of wheat in Queensland was made in 1951 by the senior author (from areas on the Darling Downs) it is probable that the disease has been present for a much longer period. Symptoms apparently similar to crown rot disease, but with the cause undetected, were reported on the Darling Downs as early as 1940.

During the last 15 years the fungus has been isolated from diseased wheat plants growing in a wide variety of soil types on the Darling Downs, and in the Maranoa, Lockyer Valley, South Burnett, Central Queensland Highlands, and

Dawson and Callide Valleys. The disease has been recorded in epidemic form in Queensland, however, only in the heavier clay soils on the Darling Downs. The expression of the disease varies markedly from season to season.

The general symptoms of the disease have been described by Butler (1961).

Both in the field and in the laboratory the fungus produces a pre-emergence rotting and a seedling blight, but the most conspicuous form of the disease is not seen until the plants are in head. Subsequent to flowering, infected plants are readily detected by the premature ripening of the ears, which contain small pinched grain or no grain at all. Such prominent deadheads become discolored and dark under wet weather conditions due to the activity of saprophytes.

Infected plants have a brown discolored crown, and the basal leaf sheaths and stem areas show a brown necrosis which becomes darker in the later stages. The basal discoloration may develop in a streak-like fashion in the early stages, when it may be confined to one side of the stem. A pink or salmon coloration may develop in the affected areas. In some seasons this may be prominent on the first, second and, occasionally, third node. In such plants the lumen is largely occupied by the fungus. A brown root-rot is associated with the infected plants as the disease develops.

Commonly the entire plant is affected, but occasionally the disease may appear only on one or more of the tillers.

The disease appears in the field as a random distribution of infected plants but in years of epidemic incidence it also occurs in well-defined patches several feet in diameter.

## II. OBSERVATIONS

*Geographical distribution on the Darling Downs.*—It has been noted that crown rot incidence varies considerably in different districts.

The distribution of the disease on the Darling Downs in the 1955 season is given in Table 1.

TABLE 1  
DISTRIBUTION OF CROWN ROT ON THE DARLING DOWNS IN 1955

Zone	No. of Farms Affected by Crown Rot	Total No. of Farms Inspected
Western	1	10
Dalby	7	26
Jondaryan-Brookstead	71	73

A survey made in the 1959 season showed that the incidence of crown rot was more widespread. Virtually every wheat crop on the Darling Downs proper, and 13 out of 78 crops inspected in the western zone, were infected to some degree. In the northern zones, however, the disease was of negligible importance. No record of crown rot was made in the Wandoan district in the western zone.

*Effect of cropping history.*—An examination of the histories of the group of 73 crops inspected in the Jondaryan-Brookstead zone in 1955 (Table 2) suggests that while age of cultivation did not appear to affect disease incidence, the length of fallow and/or cropping sequence may have exerted a conditioning influence.

TABLE 2  
EFFECT OF CROPPING HISTORY ON CROWN ROT INCIDENCE

Factor	Average Rating	Number of Crops
LAND TREATMENT		
Long fallow .. .. .	1.9	11
Short fallow .. .. .	2.1	55
Late-summer working .. ..	2.8	8
PREVIOUS CROP		
Following sorghum .. .. .	2.0	29
Following wheat .. .. .	2.3	38
AGE OF CULTIVATION		
1-5 years .. .. .	2.3	25
6-10 years .. .. .	2.5	25
11 years and over .. .. .	2.1	18

Rating Scale: The disease was rated into four classes, from 0 to 3, with 1 indicating a trace incidence of deadheads, 2 a moderate incidence of deadheads, 3 a severe incidence of deadheads.

In the 1959 survey, 21 of the best 30 crops in a series of 200 examined on the Darling Downs proper were produced on the long-fallow system following a crown-rot resistant crop. The average rating of crown rot was 1.2, compared with 2.6 for the remainder, all of which were produced on the short-fallow system.

*Effect of soil factors.*—The 1959 survey supported the common observation that the disease is more severe on heavier soils. Thus the Wandoan soils, on which no crown rot was observed, are generally lighter in texture than other soils in the western zone, in which 13 out of 55 crops were infected.

In years of epidemic incidence of the disease, it appears sometimes in well-defined patches in which virtually all plants are diseased. Within one severely infected crop, a series of readings was made with a dumpy level to

determine whether soil depressions were associated with heavy incidence of the disease. The figures in Table 3 indicate that heavily diseased patches were in all cases lower than adjacent areas randomly diseased.

TABLE 3  
COMPARISONS OF ELEVATIONS OF SEVERELY DISEASED  
AND ADJACENT AREAS

Survey Staff Readings (ft)		Differences in Readings (ft): Diseased Patch
Diseased Patch	Adjacent Random Diseased Area	
4.85	5.03	Lower by 0.18
4.80	5.00	" " 0.20
4.96	5.00	" " 0.04
4.50	4.70	" " 0.20
4.65	4.72	" " 0.07
4.65	4.70	" " 0.05
4.55	4.70	" " 0.15
4.55	4.69	" " 0.14
4.55	4.60	" " 0.05
4.55	4.65	" " 0.10
4.50	4.70	" " 0.20
4.45	4.60	" " 0.15
4.45	4.55	" " 0.10
4.35	4.55	" " 0.20
4.35	4.45	" " 0.10

*Effect of weather.*—The incidence of crown rot in relation to seasonal conditions was examined. In the nine seasons 1951 to 1959, the four seasons of severe incidence were characterized by below-average rainfall during the growing period. In the five seasons of slight incidence, the rainfall during the growing period was on the average approximately double that of the average for the four seasons in which crown rot was prevalent. Further, the prevalence of the disease in all seasons was more closely related to lack of moisture during the early stages of growth than to moisture deficiency at later stages.

During the six seasons 1960 to 1965, there was a severe incidence of crown rot in only two seasons and no relationship to seasonal rainfall was evident.

*Effect of variety.*—Eighteen varieties of wheat were inoculated with a concentrated water suspension of spores and mycelium of *F. graminearum* from agar cultures, and sown in double-row plots with four replications of each variety. The experiment was located on a clay soil which had grown a severely diseased crop during the previous season.

Six weeks after emergence the plots were sampled and rated for seedling blight. The percentages of deadheads were determined at maturity. The summarized results are shown in Table 4.

TABLE 4  
VARIETAL REACTION TO CROWN ROT

Variety	Percentage Seedling Blight		Percentage Deadheads	
Puseas .. ..	58.5	(93)*	59.0	(527)**
Warput .. ..	19.0	(50)	38.0	(473)
K41PF4473 ..	17.75	(92)	40.5	(1,178)
Charter .. ..	16.25	(131)	31.0	(1,381)
K2P4, 4620 ..	9.5	(110)	23.0	(1,549)
Ford .. ..	15.5	(35)	27.25	(386)
Celebration ..	5.0	(132)	20.25	(1,870)
Cailloux .. ..	3.25	(98)	13.75	(1,613)
Puglu .. ..	4.5	(138)	14.75	(2,337)
KGPF4521 ..	7.75	(151)	31.5	(1,722)
Seafoam (1) ..	5.75	(131)	30.5	(1,636)
Seafoam (2) ..	10.25	(142)	25.25	(1,576)
Festival .. ..	3.25	(120)	19.0	(1,703)
Fedweb .. ..	8.75	(73)	16.5	(1,063)
Lawrence .. ..	6.5	(100)	13.25	(1,283)
Kendee .. ..	10.0	(20)	35.0	(469)
Gabo .. ..	5.75	(155)	12.0	(1,998)
Spica .. ..	2.0	(68)	26.0	(1,022)

\* Number of plants examined.

\*\* Number of heads examined.

While considerable variation occurred between replicates of any one variety, it appeared that there were differences between the varieties in their disease susceptibility as evidenced by both the seedling blight and the deadhead stages of the disease. No correlation between seedling blight and subsequent deadhead incidence was apparent.

The varieties Gabo, Lawrence, Cailloux and Puglu showed the lowest percentage of deadheads.

*Effect of seed treatment.*—Two field experiments were laid down to examine the effect of seed treatment with the fungicides commonly used commercially for the treatment of wheat seed on yield on two areas which had previously grown severely infected crops. The mercurials “Ceresan” and “Agrosan”, copper carbonate and hexachlorbenzene were the treatments used. Under conditions which produced approximately 20% of deadheads, no significant yield increases were obtained following the seed dressings.

### III. DISCUSSION

The tendency for crown rot to be more severe on land that had received only late-summer working is of interest. Late fallowing may well serve to distribute diseased stubble and not allow sufficient time between cultivation and sowing for the inoculum reserves to be depleted.

In view of the association shown between soil depressions and incidence of crown rot, it is considered that the dead patches occurring in wheat crops on typical plains country reveal the original gilgai condition of the soil. The disease is more prevalent in the depression than on the "puff" (raised periphery) of the depression, the centre of which may be no more than a few feet away. The puff, besides being higher, is finer in structure and has a higher available moisture capacity.

While no relationship between frost incidence and crown rot infection has been detected, it is of interest to note that the Darling Downs, which has the highest incidence of crown rot, has the shortest frost-free period and the lowest mean temperatures of the various wheat-growing districts of Queensland.

The variety Gala (Gabo x Lawrence) was not included in the varietal susceptibility trial reported in this paper. However, it has subsequently been observed consistently to show a lower incidence of deadheads than other commercial varieties and is therefore recommended for use on infected soils.

The frequently severe incidence of the disease on virgin soil draws attention to the probable significance of seed transmission of the fungus and/or the influence of host plants other than wheat. Simmonds (1966) has listed Queensland records of *Fusarium graminearum* on barley, oats, canary seed (*Phalaris canariensis* L.), maize and prairie grass (*Bromus unioloides* H.B.K.) among cultivated plants, as well as on black oats (*Avena ludoviciana* Dur.), *Phalaris paradoxa* L. and the native grasses *Danthonia linkii* Kunth, *Dichanthium humilius* J.M. Black, *Panicum decompositum* R.Br. and *P. queenslandicum* Domin.

### REFERENCES

- BUTLER, F. C. (1961).—Root and foot rot diseases of wheat. *Sci. Bull. Dep. Agric. N.S.W.* No. 77.
- SIMMONDS, J. H. (1966).—"Host Index of Plant Diseases in Queensland". (Dept. of Primary Industries, Brisbane).

(Received for publication April 18, 1966)

The authors are officers of the Division of Plant Industry, Department of Primary Industries. Dr. McKnight is Officer-in-Charge, Queensland Wheat Research Institute, Toowoomba; Mr. Hart is District Adviser in Agriculture at Toowoomba.