QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES
DIVISION OF PLANT INDUSTRY BULLETIN No. 534

BEAN HALO BLIGHT ON PHASEOLUS ATROPURPUREUS

By J. C. JOHNSON, M.Sc.

SUMMARY

Siratro (*Phaseolus atropurpureus*) is a host of the bean halo blight bacterium *Pseudomonas phaseolicola*.

Isolates from siratro were found to be pathogenic on French beans in glasshouse inoculation experiments, and vice versa.

The pathogen can persist for long periods on *P. atropurpureus*, with little adverse effect on the stand. Such an infected stand would constitute a serious risk to green bean and bean seed production being carried on in the vicinity.

I. INTRODUCTION

Siratro, a cultivar of *Phaseolus atropurpureus* DC., is a tropical pasture legume bred by the C.S.I.R.O. Division of Tropical Pastures, Brisbane (Hutton 1962). *P. atropurpureus* is a native of Central and South America and was first introduced to this country in 1954.

Although in Queensland, as elsewhere, the main source of halo blight (*Pseudomonas phaseolicola* (Burkholder), 1926) Dowson, 1943) of French bean has always been *Phaseolus vulgaris* L., the introduction of another member of the genus to agriculture was viewed with more than passing interest. The genus is not strongly represented in Queensland. Besides *P. atropurpureus* and *P. vulgaris,* the following are known to be present—*P. aureus* Roxb., *P. lathyroides* L., *P. limensis* Macf., *P. mungo* L., *P. radiatus* L. and *P. truxillensis* H.B.K. *P. lathyroides* (phasey bean) was introduced prior to 1879* (Bailey and Tenison-Woods 1879) and is now widely naturalized. *P. aureus* (mung bean) and *P. limensis* (lima and Madagascar beans) occur in cultivation to a very limited extent, while *P. radiatus, P. mungo* and *P. truxillensis* are indigenous but confined to the far north (Bailey 1900, p. 433). None of these is considered to be an important host of halo blight disease, since they are either non-susceptible or of too limited occurrence.

"Queensland Journal of Agricultural and Animal Sciences", Vol. 27, 1970

* *P. psoraleoides* 1879 and 1883 = *P. semierectus* 1900 = *P. lathyroides*

Siratro is a hardy perennial and is becoming firmly established in many localities. The possibility that it may act as a perpetual source of bean halo blight inoculum is a matter of some importance and prompted this investigation.

II. DESCRIPTION OF THE DISEASE

In the spring of 1961, symptoms of halo blight were observed on a small plot of siratro at Redlands Horticultural Research Station, Ormiston (Oxenham 1962). (Patel and Walker (1965) have since shown this host to be susceptible in glasshouse studies). Infection was scattered over the plot with several centres of concentrated attack where the stand presented a ragged appearance. These areas were no more than 8 in. across. The leaf spots were similar to those occurring on bean, being small, up to 3 mm across, dark and watersoaked, and sometimes

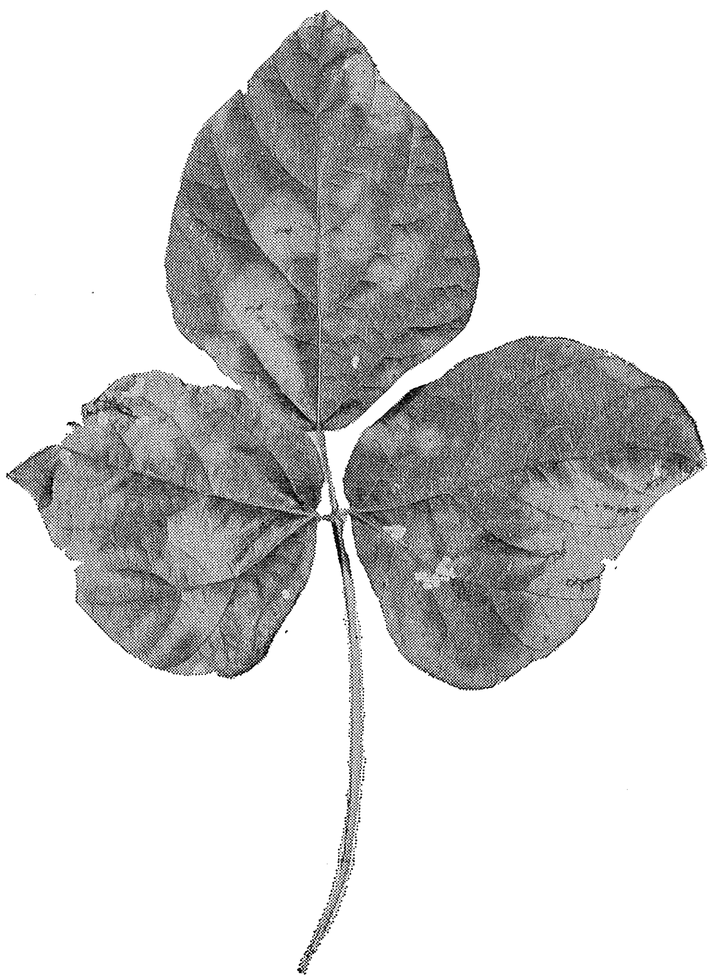

Fig. 1.—Halo blight on *P. atropurpureus*. Field symptoms.

surrounded by a broad, lemon-coloured halo (Figure 1). No symptoms were observed on the stems and leaf stalks. Occasionally it was found that terminal growth was lemon-coloured and degenerating, suggesting entry of the pathogen into the vascular tissue. The land adjacent had carried a winter crop of French beans, and although no record was made of halo blight in this planting, it seems likely that it was the original source of the infection.

III. THE PATHOGEN

Isolation.—Isolations were made from the leaf spots onto potato dextrose agar plates and colonies of bacteria resembling those of *P. phaseolicola* were readily obtained.

Morphology and physiology.—The following were the results of tests carried out on two isolates from siratro. Cells were single, rod-shaped, $1–1 \cdot 5\mu$ x $2 \cdot 0–3 \cdot 7\mu$, motile with one or two polar flagella and Gram-negative. Carbohydrates—no acid or gas from dulcitol, maltose, raffinose, glycerol, sorbitol, lactose, salicin, cellobiose, starch, erythritol and inulin. Acid was produced

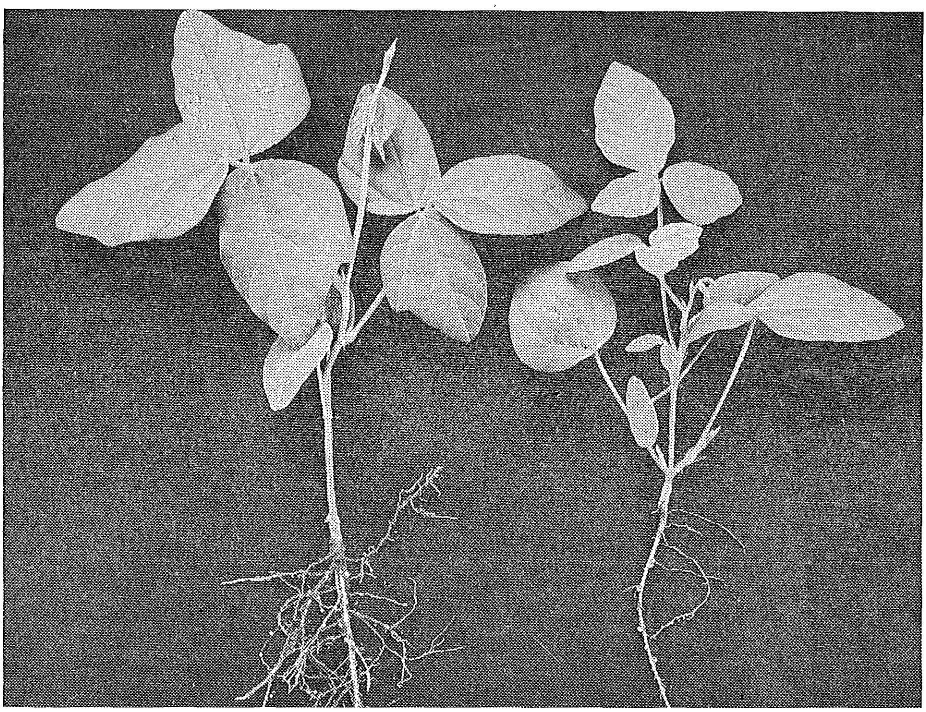

Fig. 2.—Halo blight of *P. atropurpureus.* Right, stunting and chlorosis of new growth, leading to dieback, following needle-prick inoculation above 3rd node. Left, healthy seedling of same age.

from L-arabinose, sucrose, galactose, glucose, mannose, and slightly from fructose. Litmus milk test, growth on steamed potato and H_2S production agreed, as did the fermentation tests, with the description of *P. phaseolicola* in Bergey's Manual of Determinative Bacteriology, Seventh Edition (Breed, Murray and Smith 1957).

Host studies.—The two isolates were used to inoculate both French bean and siratro seedlings growing in pots in the glasshouse. Young colonies were transferred to broth and the resultant suspension pricked into the leaves and leaf stalks of the seedlings. After 4 days, blight symptoms appeared on both hosts. Two fresh isolates from field collections of halo blight infected French beans were pricked into both hosts on two subsequent occasions and in all instances the results were the same. Spots which formed on mature leaves following inoculation were inconspicuous and dark, and lacked the characteristic halo. Immature leaves developed spots with conspicuous haloes. This character was part of the symptom picture on both hosts, but it was particularly marked on siratro. When inoculum was pricked into the main stem of siratro, chlorosis of the terminal growth and eventual dieback to the inoculation site occurred (Figures 2 and 3). Similar chlorosis and dieback occurred when the inoculum was pricked into a petiole, the infection quickly moving down into the main stem.

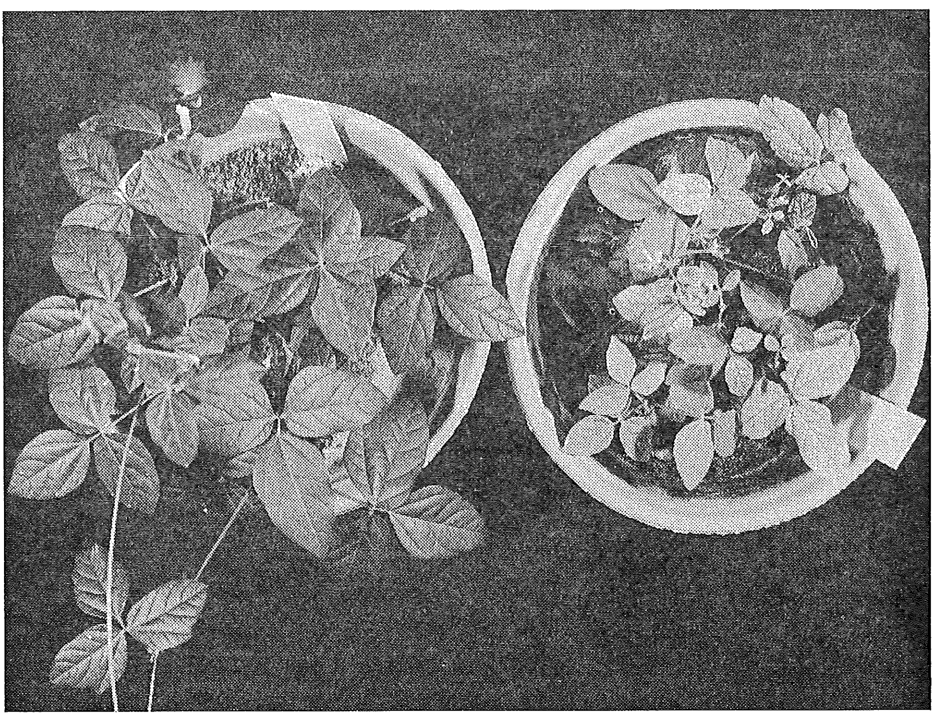

Fig. 3.—Halo blight of *P. atropurpureus*. Right, systemic infection following inoculation in the glasshouse. Left, healthy seedlings of the same age.

Subsequent regrowth from the stem below the point of inoculation was normal, and complete recovery was frequently observed. None of the cultures produced the same sudden dieback on *P. vulgaris*.

From these tests it was concluded that the disease on *P. atropurpureus* was incited by the bean halo blight organism *P. phaseolicola*.

IV. REACTION OF FIVE ACCESSIONS OF *P. atropurpureus* AND RELATED SPECIES

Siratro was derived from a cross of two Mexican strains of *P. atropurpureus* designated C.P.I. 16877 and C.P.I. 16879. These, together with other *P. atropurpureus* strains C.P.I. Nos. 16875, 16876, 18556, and two other species of interest in pasture research—*P. bracteatus* Nees & Mart. (C.P.I. 17404) and *P. lathyroides*—were examined for their reaction to inoculation with *P. phaseolicola*.

For this work the following procedure was used. The pathogen was cultured on young French bean seedlings and inoculum was prepared from freshly infected parts of stems, petioles and leaves. These were ground in a mortar with a little water and the filtered suspension was applied to the test plants by means of a pint hand sprayer. By dusting the plants previously with a little carborundum powder and abrading them gently together after applying the inoculum, a very satisfactory infection was obtained. In this inoculation an attempt was made to simulate the natural abrasive effect which occurs in the field under the influence of such agents as dust, wind and rain.

Not all plants within each line were susceptible to the same degree (Table 1). Susceptibility was gauged according to the development of the symptoms described above. Plants which did not exhibit chlorosis and dieback were classed as resistant. Such plants exhibited only leaf spots. These ranged in type from those with a characteristic halo to others which were small and brown

TABLE 1

REACTION OF THREE *Phaseolus* SPECIES TO HALO BLIGHT

Accession	No. of Plants Inoculated	No. with No Systemic Symptoms
P. atropurpureus		
C.P.I. 16875	39	4
C.P.I. 16876	26	13
C.P.I. 16877 (parent of siratro) ..	31	3
C.P.I. 16879 (parent of siratro) ..	43	0
C.P.I. 18556	56	8
P. bracteatus		
C.P.I. 17404	28	26
P. lathyroides	8	8

in colour, indicating failure of the colonies at an early stage of establishment. Plants which developed no more than leaf spot symptoms quickly recovered, sometimes shedding affected leaves prematurely. This was particularly marked in the case of *P. lathyroides.*

It is clear therefore that a wide range exists in the reactions of plants in the *P. atropurpureus* accessions to halo blight, and that *P. bracteatus* and *P. lathyroides* plants tested were, by comparison, more uniformly resistant.

V. PERSISTENCE OF HALO BLIGHT ON *P. atropurpureus* IN THE FIELD

At the conclusion of the glasshouse inoculation tests, all surviving plants of *P. atropurpureus* were transplanted to an outside garden plot where they were left to grow, with occasional cutting back, for 20 months. On numerous occasions in the interim, blight symptoms were observed on young leaves. The pathogen was reisolated from these plants on several occasions and at the end of the period, and pathogenicity to French beans was confirmed each time in the glasshouse. The total period of time over which the disease persisted from the time of inoculation was therefore 25 months. The original field infection at Ormiston was observed to persist for 12 months, after which the crop was turned in.

On neither planting was stem spotting conspicuous. Of 14 attempts to transfer infection from the few observed inconspicuous stem spots to beans in the glasshouse, only two were successful.

VI. NON-*Phaseolus* HOSTS OF HALO BLIGHT IN QUEENSLAND

In this context it should be noted that two non-*Phaseolus* halo blight hosts are grown in Queensland. These are glycine (*Glycine javanica* L.) and kudzu (*Pueraria thunbergiana* (Siebold & Zucc.) Benth.), of which only the former can be regarded as important. Glycine has recently been found to be widely infected with a particular "haloless" form of halo blight (Johnson 1969), and is perhaps a more potent source of infection than is siratro.

VII. DISCUSSION

The relative scarcity of alternative host plants in the main bean-growing areas has long been regarded as a great help in keeping halo blight under control in Queensland. The introduction and increasing use of susceptible tropical pasture legumes could bring about what might be a reversal of this situation. Presently there is intermingling of dairy farming and green bean growing on coastal lands in the south of the State, and in the far north tropical pasture legume seed is produced in proximity to commercial bean seed crops.

The above observations indicate that unless due consideration is given to segregating the two host groups in both areas, halo blight prevention in beans may be rendered much more difficult than it has been in the past.

Since these investigations were carried out, two instances of halo blight infection of siratro growing in mixed pastures adjacent to bean fields have been brought to the writer's notice. These occurrences were near Nambour on the Near North Coast where winter bean crops are grown to supply fresh beans to southern markets.

VIII. ACKNOWLEDGEMENTS

Accessions of *P. atropurpureus* and *P. bracteatus* used in this work were kindly supplied by Dr. E. M. Hutton, of the C.S.I.R.O. Cunningham Laboratory. Miss M. L. Moffett of the Plant Pathology Section, Queensland Department of Primary Industries, determined the biochemical reactions of the halo blight isolates used.

REFERENCES

BAILEY, F. M. (1900).—"The Queensland Flora Vol. II". (Government Printer:Brisbane).

BAILEY, F. M., and TENISON-WOODS, J. E. (1879).—A census of the flora of Brisbane. *Proc. Linn. Soc. N.S.W.* 4 (1st ser.): 152.

BREED, R. S., MURRAY, E. G. D., and SMITH, N. R. (1957).—"Bergey's Manual of Determinative Bacteriology." 7th ed. (Williams and Wilkins:Baltimore).

HUTTON, E. M. (1962).—Siratro—a tropical pasture legume bred from *Phaseolus atropurpureus. Aust. J. exp. Agric. Anim. Husb.* 2:117-25.

JOHNSON, J. C. (1969).—"Haloless" halo blight of French beans in Queensland. *Qd J. agric. Anim. Sci.* 26:

OXENHAM, B. L. (1962).—Report of the Plant Pathology Section. In *Rep. Dep. Agric. Stk Qd* 1961-62.

PATEL, P. M., and WALKER, J. C. (1965).—Resistance in *Phaseolus* to halo blight. *Phytopathology* 55:889-94.

(Received for publication November 4, 1969)

The author is an officer of Plant Pathology Branch, Queensland Department of Primary Industries, and is stationed at Brisbane.