PHYSIOLOGICAL STUDIES ON THE GROWTH AND RUST IN BEANS

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APPROVAL SHEET

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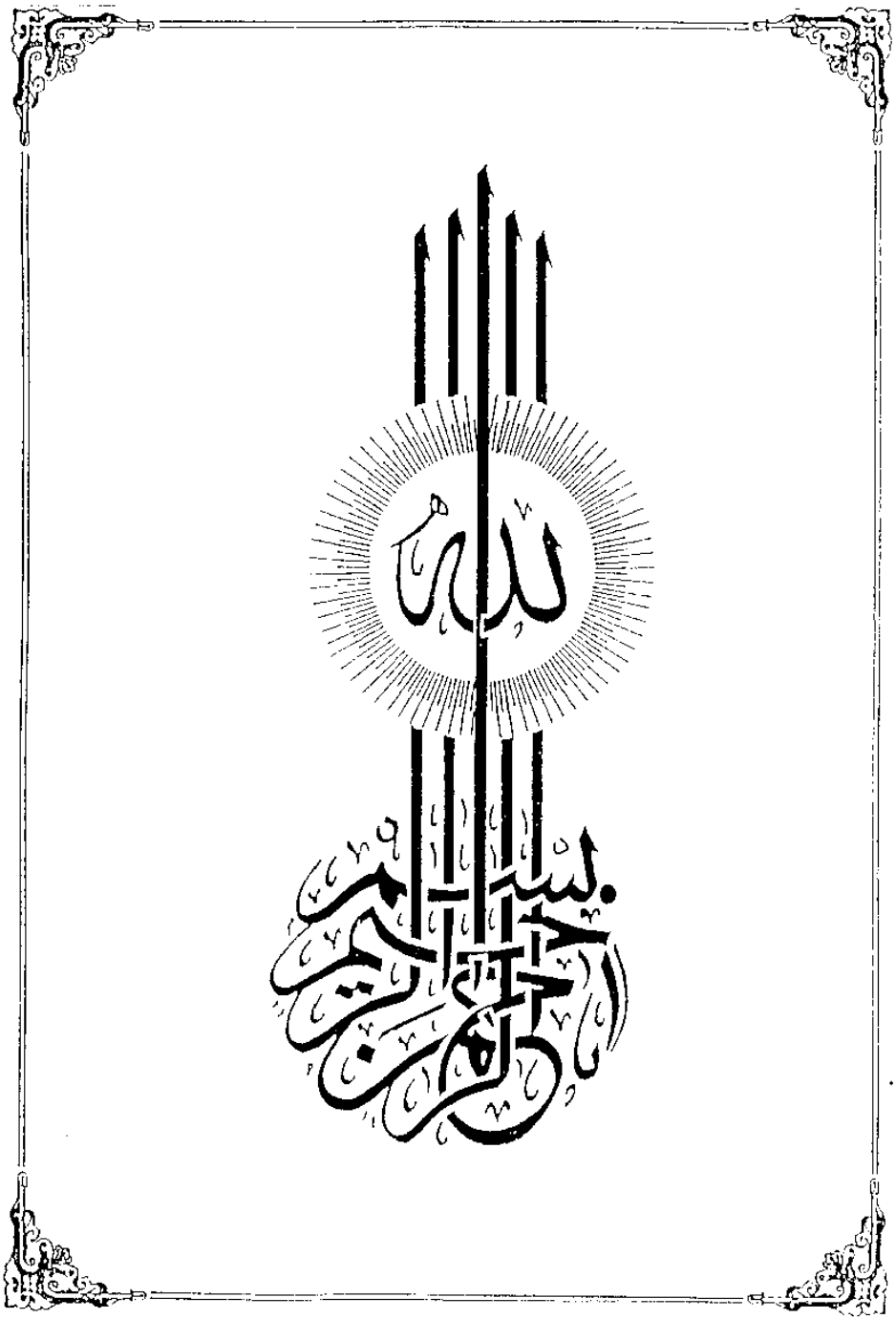

A C K N O W L E D G M E N T

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C O N T E N T S

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I N T R O D U C T I O N

Phaseolus vulgaris L., is one of the most important species of bean grown in the U.A.R. The name bean or Kidney bean applies to varieties belonging to this species. This crop is produced for market as green or dry beans. The area cultivated annually by such crop increased from 572 feddan in 1929 to 2817 in 1939, 6000 in 1949 and to 20670 feddan in 1968.

The U.A.R. Government is trying hard to raise the production of beans to meet the increasing demands of the populations and to increase the tonnage for export. Increasing the total production of bean could be achieved horizontally by expanding the area and vertically through improving the average yield per feddan. The farmer's experience varies considerably with regard to the amount of phosphorus fertilizers applied per feddan, the use of resistant varieties and improving the methods for the control of fungal diseases.

Phaseolus vulgaris suffer considerably from rust disease caused by Uromyces phaseoli typica,Arth., which causes high losses in the yield.

The present investigation was planned to study the following factors :

1) The effect of seasonal cultivation and the use of fungicides on the growth, yield and percentage of rust infection of Phascolus vulgaris.
2) The susceptibility of two varieties namely contender and seminole to the 1st. factor.
3) The effect of phosphorus fertilizers on the growth, yield and chemical constituents of the plants.

REVIEW OF LITERATURE

A. Effect of Climatic Conditions on the Growth and Production of Bean Plants :

It is known that weather conditions have great influence upon the yield of bean plants and that 25°C is considered the most suitable temperature for seed germination which do not germinate usually at 8°C or below that The most suitable temperatures for growing the plant ranges from 18.3 - 23.8°C. At high temperatures, the leaves become yellowish, while intense light cause small brown spots between the viens of the leaf blade. The bean plant flowers usually drop at high temperatures (at 35°C). This may be due to failure of fertilization to occur as a result of death of the pollen at such high temperatures.

Hartwig and Edgare (1954), concluded that planting of soybeans in the U.S.A. should be delayed until the maximum soil temperature has reached 65°F and the day length has reached or exceeds 14½ hrs. for optimum production in the southern states. They added that, when these conditions are met, beans will emerge in 5 to 7 days, and will make rapid early growth. They also reported that medium and medium-late varieties showed less reduction

in bean yield from late planting than did the short-season varieties.

Osler et al. (1954), concluded that the yield of later soybean varieties was more reduced than earlier ones by delay in planting, yet the maturity date of the lgt. varieties was less affected than the others. They added that maximum height was obtained from early planting.

Celestino and Deanon (1960), showed that, in the Philippines, yields of bush beans from November planting were 75 - 130%greater than those from February planting. They also found that Wade, Contender and Improved tender green gave the highest yields among the bush varieties.

Iwami (1953), reported a negative correlation between the temperature at 10 a.m. and the percentage set of flowers in runner and dwarf varieties of kidney beans. The same author stated that three stages of flower abscission were recognized in the runner bean; an early stage, attributed to competition for nutrients between the flowers and developing plant, a middle stage, attributed to competition for nutrients between flowers; and a late stage, associated with the decline of the plant and the effects of high temperature.

Watanabe (1953), reported that experiments with

beans showed that long sustained high temperature (30°C) and night temperature before pollen mother cell reduction division resulted in abnormal flowers, most of their pollen was abortive, and that low night temperature(15°C) was favourable for flower bud formation. The same author reported that bean plants flower naturally from midnight to sunrise. Day and night temperatures affected flowering and set was decreased by high evening temperature. Pollen activity was highest at anthesis and 10 hours before it. Moreover, pollen germination and pollen tube growth are favoured by damp conditions and moderate temperature as the optima being 94 : 100% R.H. and 20 : 25°C.

Inoue et al. (1954a), reported that tall bean varieties developed earlier flower buds than dwarf ones. They added that the environment of the very young plant affects flower formation, flowering and flower drop.

Inoue et al. (1954 b), studied pollen germination on the tall Kentuky wonder and the dwarf Masterpiece beans and reported that, the germinability was recognizable the afternoon before flowering; and the pollen grains lost their vitality about 5-6 hours after anthesis. They also reported that the optimum temperature and relative humidity for germination were 20 - 25°C and 80% respectively. The germination rate of pollen grains of plants exposed to

temperature of 25 - 30°C was greatly reduced.

Sasaki et al. (1954), reported that the yields of kidney bean varieties were higher under cooler conditions. This depended on the number of flowers produced but not on the percentage of pod set. They reported also that cool conditions, favoured flower production but under warmer conditions, seed size was decreased and the percentage of imperfect seeds was greater.

Inoue et al. (1955), found that in Kentucky wonder, about 20 - 30% of the flower buds which had differentiated by 45 days after sowing developed to flowers. Pod-setting occurred in 20 - 35% of the total flower number. Competition for nutrients and high temperatures appeared to be the chief causes of flower and pod drop. With delayed sowing, the percentage of pod set was lowered.

Ahmadi (1956), investigated the blossom abscission in dry bean variety "red kidney" under green-house conditions and showed that the optimum temperature for pollen germination was 15°C and the critical temperature was 30°C. At 32.2°C blossoms dropped from intact plants. He added that anatomical studies showed that abscised flowers were not fertilized. He concluded that blossom abscission of dry beans under adverse conditions might be due to the inability of the pollen grains to germinate.

Inoue and Shibuya (1956), studied the sowing of Masterpiece beans twice a month from mid-April to the end of August and found that, pod length was greatest in the mid-April sowing and decreased until the mid-July sowing and then increased in the end of August. The number of seeds per pod and their weight were similarly affected by the sowing date but the minimum resulted from the end of July sowing, and the mid-August and late August numbers were only 29% and 36% of the mid-April numbers.

Rappaport et al. (1956), reported that pre- and post-bloom night temperatures of 50, 60 and 70°F as well as 60 and 67°F night temperature interactions during specific stages of growth, separately and in combination, markedly affected growth, dates of anthesis and maturity, and yields of lima beans. They added that, as pre-bloom temperatures increased from 50 to 70°F, pod and seed numbers decreased. Pod weights varied consequently with foliage weights.

Ueki (1956), reported that, reduction in light intensity reduced the assimilation capacity of Masterpiece beans. At less than 30% natural light, growth was markedly checked. As light intensity was reduced, the number of latent flower buds increased and the number of flowers decreased. There was also great flower drop and poorer

pod set. Reduction in light intensity had no effect on pollen activity.

Inoue (1959), reported that, the pistel of Masterpiece bean flowers became receptive from 3 days before anthesis and the percentage fruit set increased until the day before anthesis. Fruit set was low one hour after pollination, but increased with time, and was poor at high temperatures. The best pod set was that of beans kept at 15 - 25°C for four hours after pollination.

B. Bean Rust and its Control :

Baumeyer (1947), found that sulphur dusting at 20 to 25 lb. per acre gave excellent control of bean rust. He added that control early in the season, when infection is usually sparse, is relatively simple and prevents a secondary spread. Dusting applied before the plants covered the rows particularly eliminated the disease. Plants dusted twice by sulphur showed an average yield of 1600 to 1800 lb. seed/acre against 800 to 1000 lb. in the undusted ones.

It was reported by the Agricultural Gaziet (1949) that dusting bean seedlings (two or three days after emergence) with sulphur at 15 to 25 lb. per acre was recommended in the protection from bean rust. It was

added that the application must be repeated at intervals of 1 to 2 weeks until a few days before flowering. Spraying with wettable sulphur was also effective.

Brein (1953), found that lime sulphur (1-150) plus colloidal sulphur (2 lb. per 100 gals.) gave effective control for bean rust (Uromyces appendiculatus). In later bean varieties, applications should be made when the plants are established and repeated up to 3 or 4 times at 10 - 14 days intervals.

Cosper et al. (1953), noticed (in a series of five greenhouse trails on field bean), a marked reduction in the number of rust (Uromyces phaseoli typica) pustules resulted from spraying the plants with 1/ urea or with 200 ppm Dreft (sodium lauryl sulphate). They added that a further reduction was obtained from urea and Dreft combined. The standard sulphur (undiluted sulphur) dust treatments, however, remained the most effective method of rust control.

It was reported by the Ministry of Agriculture at Colombia (1953), that in field experiments along the duration of four successive seasons using sulphur for the control of Uromyces phaseoli, the yield was increased.

Brien and Jacks (1954), showed that preliminary

tests with forty varieties of dwarf and runner beans for resistance by artificial inoculation, indicated that Lime sulphur 1 - 150 plus colloidal sulphur 2 lb. to 100 gals. was effective in controlling bean rust.

It has been reported by the Agricultural Gazette (1954),that the use of sulphur dusts or sprays gave good control of bean rust.

Jacks et al. (1954), testing thirty-three fungicides for control of Uromyces faba, found that the most effective compounds were lime sulphur, Colosul 40, Cosan, Dithane Z 78, Fermspray, Maazate, Thirospray, Puclasan Ultra, Flit 406, Phygon XL. and Spergon W.P.

Jacks and Brien (1955) found that, the effective compounds for controlling Uromyces appendiculatus were lime sulphur plus colloidal sulphur, fine wettable sulphur, Zineb, Ferban, Maneb, Thiram, Ziram, Captan, Dichlone, Chloranil and Nitrobenzene.

Casarini (1956), indicated that satisfactory results in the control of bean rust (Uromyces appendiculatus) were obtained by spraying with solutions of Ceffaro powder (1%), Ticsol, wettable sulphur (1%), Exina (a synthetic product based on zineb and not containing copper used at 0.5), and Cuprexina (a similar synthetic product, but containing copper used at 0.5%).