Effect of Photoperiod and Temperature on the Reaction to the Common Bacterial Blight Disease in Dry Beans (Phaseolus vulgaris)

Eladio Arnaud-Santana[1], D.P. Coyne[2], J.A. Beaver[3] and H.Z. Zaiter[2]

Arroyo Loro Experiment Station, SEA, San Juan de Maguana, Dominican Republic[1], University of Nebraska, Lincoln, NE[2], and University of Puerto Rico, Mayaguez, Puerto Rico[3].

Common bacterial blight disease (CBB) in beans (Phaseolus vulgaris, L.) caused by the pathogen Xanthomonas campestris pv. phaseoli (Xcp) is serious worldwide. There is only limited information on the influence of photoperiod (P) and adaptation on the reaction of beans to Xcp but the influence of temperature (T) is well documented. Four experiments were conducted to study the effect of P and T on the reaction of common bean to Xcp under growth chamber and field conditions in tropical and temperate zones using two genotypes adapted to the tropics and four to temperate climates.

Two day lengths of 12 h (short photoperiod= SP) and 16 h light (long photoperiod= LP), with an air temperature about 23.8°C and 29.4°C during 12/12 h (SP), and 16/8 h (LP) (light/dark periods) were used. The photosynthetic photon flux (APF) was about 340 μ mol.s^{-1}.m^{-2} at 110 cm below the light source. A split plot in a completely randomized design, with two replications in time, was used. The two T regimes were the main plots and the two P were the subplots. The genotypes 'G.N. Nebraska #1', 'R.K.Charlevoix' (MSU) and BAC-6 (Brazil) were randomly distributed in each subplot. Seeds of each genotype were sown in three 15 cm clay pots (two seeds per pot) to represent the experimental unit in each treatment combination and replicate. The razor blade method (devised in CIAT) was employed to inoculate a fully expanded first trifoliate leaf of three to four weeks old plants using 10^7 CFU/ml Xcp (DR-12 isolate). The disease lesion was measured in mm extending from the cut surface, with 1 mm being resistant and 4 mm being susceptible.

One experiment was conducted in Lincoln, Nebraska (NE) (spring-summer, 1986), one in San Juan de la Maguana, Dominican Republic (DR) (fall, 1985), and one in Mayaguez, Puerto Rico (fall, 1985) in the field. A split plot in a completely randomized design with three replications was utilized in NE. The two P were main plots and the genotypes G.N. Nebr #1. Sel. 27, 'Pinto UI114', 'PC-50' (DR), and BAC-6 were randomly distributed in the subplots. Each replicate consisted in two hills 90 cm in diameter with 4 plants per hill. The Xcp isolates Ek-11 (NE),DR-12 and Santiago-3 (DR) were then asigned to each genotype within each subplot. A LP of 15-16 h light was the natural day length at Lincoln during the period prior to flowering. A treatment of 12 h light (8 AM to 8 PM) was obtained by covering the plants daily with a black plastic over a wire frame starting from plants' emergence to the time of recording the disease reaction. The multiple needle method (Andrus, Phytopathology 1948; 38:757-759) was used to inoculate the leaflets with 10^7 CFU/ml for each Xcp isolate. A fully developed trifoliolate leaf, in the middle of the plant, was inoculated seven weeks after planting. A SP of 12 h light was the natural day length prior to flowering in the DR experiment. A 16 h light period was obtained by providing four additional hours of artificial light. A split plot in a randomized complete design with was used. The two P were main plots and the four genotypes (same as in NE) randomly assigned were subplots replicated four times within the main plots. Four 1.5 m rows, 0.10 m between plants within rows spaced 0.5 m apart were planted for each genotype per treatment per replication. The main plots were planted 5 m apart. A black plastic curtain 10 m long and 3 m high was pulled between the main plots just after sunset each evening and was pulled back before sunrise. The plants were naturally infected in the field with Xcp, and were rated for degree of disease

severity. The same experimental design, treatments and bean genotypes were used in the Puerto Rico experiment as in the DR. Each plot consisted of 1 m row length with 10 plants per genotype. The two P treatments were about 12 h light (natural day length) and 8 h light (SP). Black plastic tents were used to cover the plants under the SP every afternoon from 3.30 PM to just before sunrise. The multiple needle method was used to inoculate the leaflets with 10^7 CFU/ml Xcp isolate 820 (Puerto Rico). A rating scale 1 (resistant) to 5 (susceptible), was used to record the plant disease reaction in the 3 field experiments.

The Xcp reaction was more severe under the higher T than under the lower T in the growth chamber experiment. Also the Xcp reaction was more severe under the SP than under the LP. No significant interaction P x T was detected. CBB was consistantly more severe under the SP than under the LP in all field experiments. No significant interactions between P x genotype and P x isolate were detected. The genotypes G.N. Nebr #1. Sel 27 and BAC-6 exhibited the highest resistance to the Xcp isolates under both P treatments in all field locations while 'PC-50' and 'Pinto UI114'were susceptible.

The P effect on the Xcp disease reactions observed by us were nearly similar to those of Webster et al. (Pl. Dis. 1983; 394-396). They reported the CBB was more severe under 12 h P than under 16 h P using two different dry bean genotypes in a tropical location (Cali, Colombia). However, our data disagrees with the results of Schuster and Smith (Ann. Rept. Bean Improv. Coop. 1984;135-136). They did not observe a P influence on CBB disease development in dry beans under growth chamber conditions. Different host genotypes, Xcp isolates, inoculum concentration and temperature could have caused these confliting results.

Screening *Phaseolus vulagaris* Germ plasm for Leaf and Pod Reactions to Common Bacterial Blight and Rust

E. Arnaud-Santana[1], M.T. Mmbaga[2], D.P. Coyne[2], and J.R. Steadman[2]

Arroyo Loro Experiment Station, SEA, San Juan de la Maguana, Dominican Republic[1], and University of Nebraska, Lincoln, NE[2].

Common bacterial blight, incited by *Xanthomonas campestris* pv. *phaseoli* (Xcp) and rust caused by *Uromyces appendiculatus* (Ua), are limiting constraints in production of dry beans (*Phaseolus vulgaris*, L.) worldwide. To improve disease resistance more information is needed on dry bean germ plasm reactions to these two pathogens. Two experiments were conducted to study the disease reactions to different Xcp and Ua strains, and the leaf and pod reaction of 18 *P. vulgaris* germ plasm accessions (3 temperate and 15 tropically adapted) to Xcp strains,

The experiments were conducted in Lincoln, Nebraska (NE), greenhouses during fall-spring 1989-1990. The Xcp strains V_3S_8 (Dominican Republic), T-37 (Puerto Rico), and V_4S_1 and LB-2 (NE) were used. Six Ua single uredinia cultures (strains) from Honduras and one from Nebraska all with distinct virulence patterns were used.

In both experiments, a factorial experimental design of 18 x 4 combinations with two replications was utilized. The experimental unit consisted of two pots, each containing two plants per host germ plasm accession. The strain x germ plasm was assigned randomly. Air temperatures were maintained at 24-27°C day and 20-24°C night at 75% ± 15% RH. The photoperiod was extended to 12 h using supplemental light.