Pathological and physiological studies on spot blotch of barely caused by helmanthosporium sativum in A.R.E

M.I.M. Elian

Baxley is one of the important cereal crops inthe world. Helminthosporium diseases ale consideredas most destructive diseases which etta.ck this crop •.In this respect spot blotch became one of the maincause,ls of yield reduction of baIley in Egyptspecie,1ly in warm,. wet weather in coestal regions.The causal organism was isola.ted from differentlocalities in Egypt., identified end the pathogenicitywa.s det e.rmined.. The host range and viability ofthe pathogen were studied together with the activitiesof pectolytiC, cellulolytic and.oxidative enzymesfor both the paghogen and extracts of baxley plants.The relationship between resistance and chemicalcomponents of baIley plants i.e. aminO acidS, sugarsand phenolic c0mpounds and the toxic effect of culturefiltrates of the fungus were evaluated. The susceptibilityand resistance of different bal:ley variet ies tothe disease was studied. The effect of differentfungicides on linear growth of the pathogen in l~boratoryand in the greenhouse end the field was studiedalso. Results obtained could be summarized as follows:(1) spot blotch of barley in Egypt during seasons1979-81 indicated that the disease was found in- 154 -coastal legions, Delta. and the Middle Governora.tesof Upper Egypt. The highest percentages of infectionwere observed at Kefr El-Sheikh, Alexandria,De.m.iett a and deer eased gradually south-waI ds.(2) Twelve isola.t es of !!.el~inthosporj.-ill!! sat ivum wereisolated from diseased leaves showing typica.l spotblotch sympt ems. The pathogenicity test revee.ledthet the se i sola.t es vexied great 1y in t heir pathogenicitytogether with differences in morphologica.lcharacteristics and isolate No.4 was the mostvirulent isolate, whezeas, isolate No. 12 was theleast virulent one.(3) Results of the host range of Hel~intho~ori~~sativum indicated t hat the fungus has a wide hostlange in EgypL, as it was found to infect Avena.futua, Cynodon dactyl~L .~~ Lotundus,Echinochloa colonum, ~chi~2.h.1:2J!'£!'1!§.&slli,Horde~ vulgare, Loliu@ temule~~, ~olium ~erena,Oryza sa.t iVJ!, Polypogen monspelienais, Set ax ia.viridi~, Sorghum v~lgar~, Triticum vulgare and~ maize.(4) The severity of the fungus increased gradually andzeached the maximum after 1 month, then gxaduallydecreased by ageing t i~l the 18th month.- 155 -(5) The highest activities of polygalacturonase (PG),Cellulolytio (ex) and pectinmethylestrese (PME)enzymes were found in the fungal filtra.tes ofisola.te No.4 (the most viru1ent)~whereas thelowest activities were in isolate No. 12 filtrate(the less virulent).(6) As regards the effect of fungicides on enzymesactivities studies indicated that PG and exactivities were reduced with the increase in theconcentration of the tested fungicides speciallyin case of l?lant avax and ba.yleton, whe reas ,Wolfen-thiram and Dithane M22 had little effecton PG and ex enzymes activities.(7) polyphenoloxidase, Pero~ida.se, Catalase andAscorbic acid oxidase activities were relativ&lyhigher in the mycelial matrix than in the filtrateof each of the tested isolates. Also these activitieswere higher in the highly pathogenic isOlates(isolate No.4) than the least pathogenicone (isolate No. 12). These activities incYeasedalsO by increasing the incubation periods in bothmycelial matYix and fungal filtrate.(8) Adult plants showed high levels of polyphenol-!xidase activity as compared with the seedlings.- 156 -In this .respect infection with H. !!.ativJ!!!lcausedgr adual, Lncr ease in enzyme act ivity specially inthe .resistant varieties specie.llY in the seedlingstage.(9) A~ult plants and seedlings of resistant vaxietiesexhibited higher levels of peroxidase a.ctivity e.scompared with the susceptible cnes. In thisregar d the Lncr ease of per 0::

idase eC t i vi t y wasslight in susceptible varieties and higher inresistant ones specially in adult plants.(10) Catalase activity was higher in seedling and adultleaves of the tested varieties specially in resistantones. Also, infection with the pathogenexhibited higher catalase activity in the resistantcultivars than in susceptible ones.(11) Healthy leaves from seedlings and a.dult plants ofthe resistant varieties exhibited higher activityof ascorbic acid oxidase enzyme then that in thesuscept i ble onea , Inoculat i on wi t h g. .~ti.Y"..'!mresult ad an increase in aScor bic acid oxide.seenzyme activity speciallY in the leaves of resistantvarieties than in that of susceptible ones andin adult plants than 1n seedling stage.- 157 -(12) Concerning phenol Lc compounds, reSI.11 t s indicatedthat total, free, conjugated and ortho-dihydroxyphenolswere fCQlld in higher amounts in theresistant varieties than in susceptible ones.However, it was found clearly that phenoliccompounds eccumulat ed fast er in resist ant var ietiesthen in susceptible ones as a result of infectionend also by long incubation periodspec ially aft ex 10 days fr om inOcLllat ion and inre$istent plants.(13) Total and reducing sugars contents were higher inleaves of susceptible varieties than in theresist ant ones. Adult plant s conta.ined higheramounts of total and reducing sugars then theseedlings. Inoculation with li. ~~~Jv~ causedpronounced decrease in both total and reducingsugars in seedlings or adult plants of susceptiblevaxieties, whereas, inoculation induced an increasein the resistant ones.(14) Paper chIomatogrsphic analysis showed the presenceof Maltose, Sucrose, Glucose, Ga~actose andFr ac t 0 se in inoculat e4 and uninoc uLat ed leaves ofall the tested varieties in both seedlings andadult plants. However, no ·clear correlation wasfound between resistance or susceptibi1ity ofthe tested barley varieties and any of theabove-mentioned sugasSt(15) Concernj~g of total free amino acids, theircontent increased as a result of inoculation withHelm1~~hosporium sati~ in both resistant andsusceptible vaxieties in the seedlings as well asin adult plents. In this regard, susceptiblevarieties contained higher levels of total freeamino acids than the resist ant ones in both Eeedlingend adult plant stages. However, e.dultplants contained higher amounts of amino acidsthan seedlings.(16) Qualitative analysis indicated the presence ofseventeen amino a.cids namely Cystine, Lycine.Histidine, Arginine, Aspazatic acid, Glycine,Serine, Glutamic, Therionine, Alanine, Proline,Tyrosine, Methionine, Valine, phenylalanine,Leucine and Iso-leucine in seedlings as well asadult plents of resistant and susceptible varieties.(17) The amounts of total amine acids inczeased as8 xesult of infection in both the susceptible andzesistent varieties as compared with the uninoculatedcontrcl.(18) 'rhe quantities of carta.in amino acids as Lycine,Histidine and Arginine were higher in the susceptiblevazieties then resistant ones, wheree.s thecontrast we.s noticed as regards Tyrosine endphenylalanine. On the other hend, ProlineappeeIed with higher concentrations in the susceptiblevezieties than the resistant ones in bothseedlings and adult stages and its concentrationswere higher in healthy plants as compared withinocule.t ed ones.(19) In response to inoculation with Ii· s§;.liV:~.mTylcsineand Phenylalanine quantities increased in theresistant vaIieties and decreased in the susceptibleones. In this respect, Methionine and Valine increasedas a result of infection in resistant varietiesin the seedlings. The highest amoants ofLyeine, Histidine and Arginine were obtained in theinfected susceptible varieties. As for, the otheramino acids no general trend was noticed in eitherresistant 01 susceptible varieties.(20) The elude culture filtrate of two isolates ofH-. sativum (one virulent and the other avirulent) .--,-.""".....--._'----induced inhibitory effect on the percentage of seedgermineti(n, lengths of cole~ptile and roots on ell- leU ••the testlj-d varieties.. HpweveI, the high concent-Iation of crude culture filtrate W8.S the mosteffective in this I espect. This effect decreasedproporticne.llY with the dilution of crude filtrate.In this regard the most effective flitretewas take:n from 30 daYS eLd cultures end was thatof the most virulent isolate No.4.(21) One to:x:_c fraction waS isola.ted in crystaline f cr m(rod cz:,stals), according to the method adopted byLindberg (1971), and Turner (1971) and was identifiedas Helminthospcral. In this regard the virulentiselete No.4 produced 4.633 go/liter ofeultuI€ medium of toxin; while the less virulentisola.te NO. 12 p:r:oduced 2.461 g./liter of cut t uremedium. The toxin gave simileI symptoms on seedlingsand adult plants and effects as mentionedbefore. However, the phytoxic effect of the toxindecreased proportionallY by decresing its concentration.(22) Sczeening of 37 selected baxley varieties undergreenhouse conditions in the seedlings, indicatedthat 16 vexieties weze highly resistant and 5varieties were moderately susceptible, while !6vazieties were susceptible. (n the other hand,under field conditions in adult stage resultsindicated that from 44 varieties, 19 were

resistant,4 modeIately susceptible, 13 susceptible and8 were very susceptible.(23) As regards the correla.tion between the beha.vioUIof 45 v8xieties in both seedling and adult ,stages,it was fClxod that these vaIieties could be put intwo gr~ups as follows:A- Thefrist group in which there was no effectof plant age on the vaxietel resistance orsusceptibility as follows:1. Seven vBxieties were resistent in bothseedlings and adult stages.2. Fourteen varieties were susceptible inboth seedlings and adult plants.B- The second group in which there waS an importanteffect of plant age on the varietal resistanceor susceptibility as folloWS:1. Eleven varieties showed increasingresistance with age.2. Six varieties were susceptible in theseedling stage end became resistantwith age.3. Seven varieties showed increasing susceptibilitywith age.(24) Soreening fungicides !a vitro showed that thetested fungicides varied in their effect onfungal gIowtn. However, all the fungicidesexcept Bevistin and Spergon almost stopped thelinear growth of ~. ~~tivumat relatively loweoncentr a.tions of 100 ppm. This effect in •.creased with the increase in concentrations.The fungicides Wolfen thiram, Dexon, Plsntevax~d Dithane Mcompletely inhibited the fungalgrowth at the concentrations of 50, 200, 400and 400 ppm respectively.(25) Using these fungicides as seed dressings undergreenhOuse increased the percentage of seed germination,the number of ears per pot, the weightof grains in gm per pot and 100 grains weight.On the other hand, the severity of infection wasxeduced as the fungicides were applied. However,wo].fsn *hiram, Dexon and Spergon were super ior inthis respect while Vitavax and Brassteol followedthe afolementioned fungicides in tneir effect,whereaS, Bavistin was almost uneffective.(26) Using these fungicides as foliage spraY undergreenhOuse conditions (after artificial infectionby splaying with a spore suspension at the concentrationof 80,ouO - 100,000 conidia/ml. ofBelminthoephorium sativum), the severity of infectionwas reduced while the weight of grains perpot and $be 100 gxains weight significantly increasedPlantevax end Dithane M.45 (Mancozeb) were •supezior in this respect while Dlthane M22 (Mane~and Bayleton followed them.(27) Using these fungicides as seed dressings underfield conditions showed tha,t all the tested fungicidesreduced the severity of infection and significantlyincreased the yield and weight of 1000grains. In this respect, Wolten thiram, Dero.n andVitavax were superior to the other tested fungircides. Un the other ~aad, by using fungicides foroliage spray under field conditions after artiicialinfection by spraYing spore suspension ofelmlnthos Ottum Bativum, the severity of infectionwas reduced as the fungicides were applied whereassignificant increase in the yield for each plot andthe weight of 1000 grains was noticed. Dithane M45end Plentavax were super io.r in this respect to theother tested fungicides.