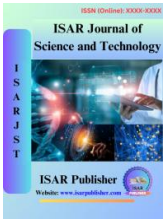
OPEN ACCESS



ISAR Journal of Science and Technology

Volume 2, Issue 11, 2024, Page: 35-41

Abbriviate Title- ISAR J Sci Tech

ISSN *(Online)*- 2584-2056

https://isarpublisher.com/journal/isarjst

Evaluation of Common Bean (*Phaseolus vulgaris* L.) Varieties against Angular Leaf Spot and Fusarium Wilt Diseases under Field Conditions in Ari Zone, South Ethiopia

Wondimu Adila Adamo[1*], Yosef Berihun Tadesse[1] and Kedir Bamud Fedilu[2]

[1]South Ethiopia Agricultural Research Institute, Jinka Agricultural Research Center department of Crop Protection, P.O.box.96. Jinka, Ethiopia

[2] Central Ethiopia Agricultural Research Institute, Worabe Agricultural Research Center, Department of Crop Protection, Worabe, Ethiopia.

***Corresponding Author**

Wondimu Adila, Adamo

South Ethiopia Agricultural Research Institute, Jinka Agricultural Research Center department of Crop Protection, P.O.box.96. Jinka, Ethiopia.

Article History

Received: 15.09.2024
Accepted: 01.11.2024
Published: 30.11.2024

Abstract: Two frequent bean diseases that significantly reduce yield in Ethiopia, including study regions, are fusarium wilt and angular leaf spot. Nonetheless, a discernible discrepancy exists between the crop's actual and potential production. Therefore, during the main cropping season of 2022 and 2023, the study was carried out in Debub Ari district and Jinka main Research station to assess how newly released common bean varieties responded to fusarium wilt and angular leaf spot diseases. Using a randomized complete block design with three replications, field tests were carried out using 22 common bean cultivars. The current study depicted that mean percent severity of fusarium wilt ranges from 24.07 up to 91.66% and angular leaf spot ranges from 8.89 up to 78.9% between tested varieties. Rore Variety reduced mean severity by 60.6% fusarium wilt and 92.98% angular leaf spot epidemics in comparison with Local variety. The highest average yield were recorded from Rore (2.4t/ha) and SER-125(2.2t/ha) whereas the lowest yield from Local (1.17t/ha and Waju (0.855t/ha) varieties. In addition to producing significant yields in both sites and seasons, SER 125 and Rore demonstrated a consistent resistance reaction against fusarium wilt and angular leaf spot. Therefore, it is better to use Rore and Ser-125 with proper management practices in production to reduce Fusarium wilt and angular leaf spot epidemics in Ari Zone and allied agro-ecologies. Furthermore, evaluating those varieties along with other potential bean candidates, to multiple disease resistance reaction across districts should be considered in the future screening studies.

Keywords: ALS, Common bean, fusarium wilt, Resistance reaction, Severity, Yield.

Cite this article:

Adamo, W. A., Tadesse, Y. B., and Fedilu, K. B.., (2024). Evaluation of Common Bean (*Phaseolus vulgaris* L.) Varieties against Angular Leaf Spot and Fusarium Wilt Diseases under Field Conditions in Ari Zone, South Ethiopia. *ISAR Journal of Science and Technology*, *2*(11), 35-41.

1. Introduction

The world's second most significant pulse crop after soybeans, common beans are versatile (Parades *et al*., 2009, Kimino *et al*., 2016). It produced 22.8 million MT worldwide (FAOSTAT, 2014) and 520 979.327 ton domestically (CSA, 2018). However, both biotic and abiotic factors limit its productivity (Kimino *et al*., 2016).

Major diseases which constraints production .ALS = *Phaeoisariopsis griseola*,Anthracnose = *Colletotrichum lindemuthianum*, Rust = *Uromysis appendiculatus, Fussarium wilt* CBB = *Xanthomonas campestris* pv. *phaseoli* are the dominant ones (Chemeda and Tadele,2006).Angular leaf spot is one of the most destructive diseases of common bean in tropical and subtropical regions of the world (Allorent and Savary, 2005, Kimino *et al*., 2016; Aytenfsu *et al*.,2019, Daba,2022).Temperature 18 to 24^{o}C ,high humidity (>70%) favors disease development (Daba,2022, Fekede *et al*.,2022).

Angular leaf spots , prompted by *P. griseola*, and is one of the most destructive diseases of common bean in tropical and subtropical countiries of the world (Allorent and Savary, 2005, Aytenfsu *et al*., 2019). It causes a yield loss of 70 to 80% depending on variety susceptibility, environmental conditions and pathogenicity of the pathotypes (Singh and Schwartz, 2010). The pathogen has great variability, which elucidates the large number of existing races and the complexity of genetic resistance which is favored by intermittent dry-wet and warm-cool (Aytenfsu *et al*.2019, Adila *et al*.2021a). Under favorable temperature conditions of 18 to 24°C, high humidity (>70%) and in the presence of a susceptible host, the pathogen has the ability to colonize different parts of plants including leaves, pods and seeds (Aytenfsu *et al*., 2019,Fekede *et al*.,2022).

Fusarium oxysporum is considered a soil inhabitant which is economically important bean disease and discoloration of the vascular tissue is primary symptom (Saremi , 2005, Pereira et al., 2011; 2016; 2018)). Commonly, the fusarium wilt diseases affects common bean any growth phase from seedling up to harvest and majority of plant death appears to occur when plants are in the seedling stage to the four-leaf stage of growth (Schwartz *et al*., 2005,Daba,2022).Dfferent common bean exhibits varied resistance reaction to fusarium wilt diseases(Pereira et al.,2019).However, those varieties were not evaluated for those diseases in our thematic areas of South Omo zone. Both diseases are the most common disease in our study areas of South Omo zone(Adila *et al*.2021a, Adila et al.,2021b).Therefore, evaluating and identifying common bean varieties resistant/toleran is mandatory. Thus, the objectives of the study was to evaluate the resistance reactions of selected common bean varieties to angular leaf spot and Fusarium wilt

2. Materials and Methods

Briefing of Experimental Locations

The study was carried out at two different hotspot locations in the 2022-2023 main cropping seasons. One of the field experiments was conducted at Jinka Agricultural Research Center, on station. It is located at geographic coordinates of 36 o54.42″E and 05°78.55″N and at an altitude of 1403 m.a.s.l. The monthly average temperature ranged between 16.8 and 30.4 °C. The mean annual rainfall for the area is 129 mm during the experimental period. The second feld experiment was executed at Debub Ari district (on farm), which is located in between 36°30′and 37°73′E and 05°67′–6°19′N and at an altitude of 1605 m.a.s.l. The district is characterized by mean monthly temperature of 13.6–28.6 °C. Mean annual rainfall and monthly temperature ranges are organized from National Meteorology Agency, Southern branch.

Planting materials and design

The experiment were consisting of 22 common bean commercial varieties with the objective to evaluate the response of varieties to resistance reaction against Angular leaf spot and fusarium head blight with their agronomic performances. Those common bean varieties were DRK ,Awash-1 , Tabor, Dimtu, SER- 119, Awash-mitin , Awash-2, Kat-B9 ,SER- 125 Dursitu, Nasir ,Awash-melka,Batu,Dinknesh, Bragit-2, Rore(SCR-26), Ibado, Remeda, Waju Gebeba , Hawassa-Dume and Local and the experiments were arranged randomized complete block design with three replications. Those listed varieties were tested for angular leaf spot (Aytenfsu et al., 2019) and fusarium wilt which ascertained different response by different locations. However, varieties were not evaluated for their reaction to angular leaf spot and fusarium wilt in the study areas.

Growth and yield data

Growth parameters such as days to 50% flowering, plant height and days to 90% physiological maturity were recorded. Days to flowering was recorded by counting the number of days after emergence when 50% of the plants per plot open flower. Days to maturity was recorded by counting the number of days required from emergence up to days when 90% of pods per plant matured per plant. Plant height (cm) was measured using a caliper at physiological maturity stage from the harvestable rows of five randomly taken plants. Mean of five randomly measured plants were used for analysis.

Three central rows were harvested to decide grain yield (g) and documented on a plot basis. Grain yield was corrected at 12% based on seed moisture content, and it was converted to t ha−1. Seed counter and sensitive balance were used to determine hundred seed weight (g) as random sample of the total adjusted yield. Five plants were randomly taken from central rows to calculate yield-related components, which consisted of number of pods per plant (NPP) and number of seeds per pod (NSPP). Pod number per plant was determined by counting pods of the five randomly selected plants, while NSPP was recorded by counting the total number of seeds in a pod from fifteen randomly sampled pods taken from previously considered five plants.

Disease Assessments

Disease severity of ALS was measured on leaves using 0-5 rating scale, 0 = No disease,1 = 1-10% leaflet area with lesions,2 = 11-25% leaflet area with lesions,3 = 26-50% leaflet area with lesions and limited chlorosis, 4 = Over 50% or more of the leaflet area with lesions and extensive necrosis, 5 = Defoliation (Inglis et al., 1993). Disease severity of FW was evaluated for reaction to FW using (1-9) CIAT disease severity scale (CIAT, 1987).

Data analysis: Data on number of pods per plant, seed per pod, 100-seed weight, grain yield and plant height was subjected to ANOVA. It was analyzed using SAS software 9.0. Differences between means were separated using Duncan's multiple range taste (DMRT) at 0.05 probability level. The two locations had relatively different weather conditions because of heterogeneity of variance as tested by F- test and results of the F-test for most the parameters were found significant at $p \leq 0.05$, $p \leq 0.01$ and $p \leq 0.001$.Thus, separate data analyses were employed

3. Results and Discussion

Disease severity index and AUDPC

Different types of common bean varieties were ascertained mean severity on fussarium wilt and Angular leaf spot (Table 1 and 2).Highest Fussarium wilt recorded from varieties Bragit-2 while lowest from Rore at JARC-on station. And also, highest fussarium wilt AUDPC from bragit-2 and lowest from Rore variety at JARC on station. At JARC on station, highest angular leaf spot mean severity recorded from varieties Awash-1.Awash melka and Awash-2 while lowest from Rori variety. Misgana et al., 2019 reported different varieties have varied effect on disease epidemics. Highest ALS AUDPC from variety Awash melka while lowest from Rore variety (Table-1) and highest fussarium wilt AUDPC from variety DRK whereas lowest from Rore and Awash-2 from JARC on station. Nearly similar trends were traced on Shishir location (table-2). Marcio et al., 2017 reported different common bean varieties have varied effect on fussarium wilt epidemics. Across season and location varieties Rore and SER-125 showed consistent reaction for both angular leaf spot and fusarium wilt diseases

Table 1. Mean result of fussarium wilt and angular leaf spot at JARC on station during 2022 main cropping season

Common bean	**Fussarium wilt**		**Angular leaf spot**	
Varieties	PSI	AUDPC	PSI	AUDPC
Ibado	73.14ab	1494.4abc	13.33g-j	254.17kl
DRK	84.25a	1438.9bc	20.00f-i	443.75ghij
Kat-B9	84.25a	1313.9c	25.83c-g	497.92ghi
Waju	38.88e-g	966.7de	23.33d-h	377.08ijk
Gebeba	85.18a	1608.3ab	16.66f-j	364.58ijk
Batu	76.85ab	1400.0bc	21.66e-i	393.75hijk
Remeda	74.07ab	1575.0ab	11.66g-j	262.50jkl
Rore	24.07i	447.2i	3.33j	77.08i
Ser-125	51.85c-e	836.1def	10.83h-j	112.50i
Tabor	30.55hi	858.3de	35.00b-e	579.17efgh
Ser-119	35.18e-g	600.0fghi	7.50ij	160.42i
Local	61.11bc	1025.0d	47.50ab	754.17bcde
Bragit-2	91.66a	1730.6a	29.16c-f	491.67ghi
Dimtu	36.11e-g	530.6hi	48.33ab	737.50cde
Hawassa-Dume	49.07c-f	997.2d	45.83ab	695.83def
Dursitu	37.96eg	747.2efgh	37.50bc	537.50fghi
Nasir	59.25bd	994.4d	36.66b-d	527.08fghi
Awash-2	34.25e-g	447.2i	52.50a	927.08ab
Dinknesh	40.74dg	45.83ab	45.83ab	845.83abcd
Awa-mit	38.88fe-g	827.8defg	43.33ab	620.83efg
Awa-mel	41.66d-g	733.3efgh	52.50a	927.08ab
Awash-1	34.25e-g	530.6hi	54.16a	979.17a
CV (%)	18.94	15.10	24.47	21.92

PSI= percent severity, AUDPC = area under disease progress curve

Table 2. Mean result of Fussarium wilt and Angular leaf spot at Shishir Debub Ari Woreda during 2023 main cropping season

Common bean	**Fussarium wilt**		**Angular leaf spot**	
Varieties	PSI	AUDPC	PSI	AUDPC
Ibado	53.087c	900.0b	16.66fgh	416.7ghi
DRK	62.963ab	1018.8a	22.23fg	566.7fg
Kat-B9	60.493bc	859.3b	25.56ef	533.3gh
Waju	27.160def	503.7fgh	36.70de	561.3fg
Gebeba	53.087c	633.4de	10.00h	183.0jkl
Batu	58.027bc	859.3b	16.70fgh	333.3ijk
Remeda	51.853c	796.3bc	10.00h	205.7jkl
Rore	19.75fgh	370.4jkl	11.10gh	122.3 l
Ser-125	16.05gh	285.2l	8.89h	166.7jkl

Tabor	27.163def	540.8efg	42.20cd	788.7e
Ser-119	24.69efg	470.4fghijk	9.99h	216.7jkl
Local	35.800d	733.4cd	65.567b	994.3cd
Bragit-2	71.607a	1033.2a	14.43fgh	350.3hij
Dimtu	27.160def	500.0fghi	50.00c	833.3de
Hawassa-Dume	25.930ef	522.2efgh	73.33ab	1211.3b
Dursitu	22.22efgh	440.8ghijk	48.90c	839.0de
Nasir	29.627de	574.1ef	50.00c	777.7e
Awash-2	18.51fgh	385.2ijkl	52.50a	1172.3bc
Dinknesh	25.92ef	481.5fghij	38.90cd	733.7ef
Awa-mit	18.517fgh	407.4hijk	66.633b	1161.0bc
Awa-melka	14.81h	355.6kl	78.900a	1422.3a
Awash-1	30.867de	577.8ef	8.89h	155.3kl
CV (%)	16.11	11.80	20.75	18.23

PSI= percent severity, AUDPC = area under disease progress curv

Yield and Yield components of common bean

Analysis of variance depicted that the highest yield from variety Rore while lowest from Bragit-2 but statistically non-significant difference with varieties Ibado, DRK,KatB-9,Gebeba,Remeda and Batu (Table-3). Aytenfsu et al., 2019 reported that varied yield responses to angular leaf spot and other related foliar diseases. Similar reports from Kimno et al., 2016.

Yield related traits showed varied responses to angular leaf spot and fusarium wilt diseases (Table 3 and 4).Number of pods per plant, seeds per pods and hundred seed weight were showed statistically significant differences among and within varieties as well as experimental locations. Adila et al., 2021a reported that yield components of different common bean varieties were ascertained varied responses to fungal and bacterial diseases at different agro-ecologies in Southwestern Ethiopia. And aslso similar reports from Aytenfsu et al. 2019.

Table: 3. Mean result of yield and yield components of common bean varieties JARC on-station 2022

Common bean varieties	**PH(cm)**	**PPP**	**SPP**	**Yield/kg/ha**	**HSW (gram)**
Ibado	18.86h	1.20ij	1.40h	178.70f	39.16a
DRK	21.06gh	1.40ij	1.40h	150.54f	37.91ab
Kat-B9	20.26gh	1.33ij	1.83h	167.40f	33.83c
Waju	44.60a	2.60h	3.70f	559.43e	36.25b
Gebeba	20.33gh	0.80j	1.30h	133.88f	33.50c
Batu	20.40gh	1.13ij	1.46h	132.57f	32.00dc
Remeda	23.20f-h	1.80i	2.46g	225.93f	31.00d
Rore	38.00a-c	8.33b	4.91b-d	1596.98a	27.16e
Ser-125	28.33d-g	5.53de	3.90ef	1243.05b	23.83f
Tabor	40.60ab	9.00a	5.77a	1171.96bc	23.75f
Ser-119	31.60c-e	6.10d	5.42ab	1325.82b	23.16fg
Local	30.66c-f	3.53g	4.50c-d	468.78e	22.66gf
Bragit-2	22.80f-h	1.13ij	1.33h	126.13f	22.40gf
Dimtu	33.80b-e	7.13c	4.86b-d	1245.43b	22.33gf
Hawassa-Dume	26.13e-h	5.40e	4.75b-d	571.01d	22.00f-h
Dursitu	33.40b-e	6.93c	5.22ab	1034.60c	21.50gh
Nasir	37.60a-c	3.46g	4.33d-e	739.71d	21.50gh
Awash-2	40.13ab	9.26a	4.94b-d	1320.90b	21.33gh
Dinknesh	31.26c-e	4.66f	4.98b-d	1061.35c	21.33gh
Awa-mit	31.33c-e	3.93g	5.06bc	771.46d	20.16hi
Awa-mel	35.60b-d	6.06d	5.30ab	746.70d	18.33ij
Awash-1	38.60a-c	7.86b	5.40ab	1228.33b	16.66j
CV (%)	14.32	8.07	9.30	12.46	4.29

PH= plant height, PPP= pods per plant, SPP= seeds per pods, HSW= hundred seed weight

Table 4. Yield and yield components common bean at Shishir kebelle Debub Ari district on farm during at 2023 cropping season

Varieties	**PH(cm)**	**PPP**	**SPP**	GY(kg/ha)	**HSW(gram)**
Ibado	24.33hi	3.80H	3.00fghi	870.4hij	38.500c
DRK	27.33fghi	3.93H	3.33efgh	657.4lm	46.500a

Kat-B9	21.00i	4.13GH	2.5333i	759.3jkl	37.000d
Waju	114.00a	4.80FGH	3.80cde	712.9kl	31.667e
Gebeba	25.67ghi	5.13EFG	2.8667ghi	1213.0d	45.00b
Batu	21.33i	5.20def	2.800hi	851.9ij	38.667c
Remeda	36.33ef	5.40cdef	2.7333hi	1207.7d	45.000b
Rore	35.33efg	6.200abcd	4.6000ab	2583.3a	27.333f
Ser-125	34.00efgh	6.9333a	4.13bcd	2620.3a	25.833g
Tabor	74.00b	6.7333a	4.7667a	953.6ghi	20.167ij
Ser-119	26.00ghi	6.7333a	54.6667ab	1870.3b	25.500g
Local	53.67c	6.8667a	3.600def	481.5n	16.833mn
Bragit-2	25.00hi	5.13efg	3.0667fghi	218.5o	28.167f
Dimtu	47.00cd	6.8667a	4.7333ab	1085.1ef	19.500jk
Hawa-Dume	29.00efghi	6.400abc	4.20abcd	1259.3d	21.833h
Dursitu	38.67de	6.8667a	3.2667efgh	1379.7c	18.500kl
Nasir	66.33b	6.13abcde	4.7667a	1196.0de	20.333ij
Awash-2	32.67efgh	6.400abc	3.4667efg	1009.4fg	16.500mn
Dinknesh	46.67cd	6.13abcde	4.20abcd	1777.7b	21.000hi
Awa-mit	47.67cd	3.93g	4.2667abc	824.1jk	16.000n
Awa-mel	27.67fghi	5.46bcdef	3.7333cde	564.8mn	14.500o
Awash-1	26.67fghi	6.4667ab	4.1333bcd	981.5fgh	17.500lm
CV (%)	14.94	10.85	9.88	6.04	3.26

PH= plant height, PPP= pods per plant, SPP= seeds per pods, HSW= hundred seed weight

Conclusion

Angular leaf spot and Fussarium wilt is a major disease of common bean that demands a better attention in the study area. The varieties Rore and SER-125 appear to have better resistance against the epidemics of both diseases with promising yield advantage as compared to the other tested varieties. Those varieties showed consistent resistance reaction and yield potential across location and season. Thus, it is better to use Varieties Rore and SER-125 with other management options for the control of both diseases in the study area

Acknowledgements

We would like to thank Southern Ethiopia Agricultural Research Institute for the financial support and Jinka agricultural center for encouragement during experiment

References

1. Adila , A., Terefe H., and Bekele, A.,2021. Common bacterial blight (Xanthomonas axonopodispv. phaseoli) resistance reaction in common bean genotypes and their agronomic performances in Southern Ethiopia. *Journal of Crop Science and Biotechnolo**gy*.** **https://doi.org/10.1007/s12892-021-00087-4.**
2. Adila, W., Terefe, H., and Bekele, A., 2021. Association of common bacterial blight (*Xanthomonas axonopodis pv. phaseoli*) epidemics with agro ecological factors in Southwestern Ethiopia . Int. J. Agril. Res. Innov. Tech. 11(1): 74-83. https://doi.org/10.3329/ijarit.v11i1.54469
3. Allorent , D. and Savary, S., 2005. Epidemiology characteristics of angular leaf spot of bean: a systems analysis. *European Journal of plant Pathology* .113(4):329-341.
4. Aytenfsu,M, Terefe, H., and Ayana , G., 2019. Aggressiveness of *Phaeoisariopsis griseola* isolates and reaction of common bean varieties to the isolates under greenhouse conditions.African journal of Agricultural research, 14(32):1553-1567**.**
5. Chemeda Fininsa and Tadele Tefera., 2006. Multiple disease resistance in common bean genotypes and their agronomic performances in Eastern Ethiopia. *International Journal of Pest Management.* 52: 291-296.
6. CIAT (International Center for Tropical Agriculture). 1987. Standard systems for the evaluation of bean germplasm. *International center for Tropical Agriculture*, CIAT, Cali, Colombia, 54p.
7. CSA (Central Statistical Agency). 2018. Report on area production of major crops (private peasant holdings) in *Meher*

Season: Agricultural sample survey. Volume I, *Statistical Bulletin* 586, Addis Ababa, Ethiopia.

8. Daba, E., 2022. Major Insect Pests and Diseases in Common Bean (Phaseolus vulgarisL.) Production in Ethiopia. Frontiers, 2(2):79-87.doi: 10.11648/j.frontiers.20220202
9. FAOSTAT (United Nations Food and Agriculture Organization). 2014. Dry Bean. Statistical database. (http://faostat.fao.org/site/567/default.aspx#ancor).
10. Fekede G., Chemeda F., Habtamu T., & Berhanu A., 2022. Evaluation of common bean (Phaseolus vulgaris) genotypes for resistance to common bacterial blight and angular leaf spot diseases, and agronomic performances. Heliyon,:
11. https://doi.org/10.1016/j.heliyon.2022.e1045
12. Inglis, J.T., 1993. Traditional Ecological Knowledge: Concepts and Cases, International Development Research Centre (IDRC), Ottawa.
13. Kimno, S.K., Kiplagat, O.K., Arunga, E.E. and Chepkoech, E., 2016. Evaluation of selected French bean (*Phaseolus vulgaris* L.) genotypes for resistance to angular leaf spot (*Pseudocercospora griseola*) in Western Kenya. *American Journal of Experimental Agriculture*, 13(4):1-6.
14. Marcio, C.de Borba, Felupe R Garces-Fiallos and Marciel J.S. Standnik., 2017. Reactions of black bean seedlings and adult plants to infection by *Fusarium oxysporum* f. sp. *Phaseoli. Crop Protection.96:221-227*
15. Parades, M.C., Becerra, V. and Tay, J.U., 2009. In organic nutritional composition of common bean (*Phaseolus vulgaris* L.) genotypes race Chile. *Chilean Journal Agricultural Research.* 69: 486 -491.
16. Pereira , DG, Faria LC, Souza TLPO and Melo LC., 2019. Selection of parents and segregating populations of black bean resistant to fusarium wilt with high yield and seed weight. Genet. Mol. Res. 18: GMR18276.
17. Pereira HS, Faria LC, Wendland A. and Costa JGC,2018. Genotype by environment interaction for disease resistance and other important agronomic traits supporting the indication of common bean cultivars. Euphytica. 114: 12.
18. Pereira, HS, Melo LC, Souza TLPO and Faria LC., 2016. Resistance to Fusarium wilt in common bean cultivars and lines in pre-commercial stage. Annu. Rep. Bean Improv. Coop. 59: 103-104.
19. Pereira, MJZ, Ramalho MAP and Abreu ÂFB (2011). Reação de linhagens de feijoeiro ao fungo Fusarium oxysporum f. sp. phaseoli em condições controladas. Ciênc. Agrotec. 35: 940-947.
20. Saremi H., 2005. Fusarium Biology, Ecology and Taxonomy. Ferdowsi University of Mashhad, Iran. pp.152
21. Schwartz HF., Steadman, JR., Hall R., and Forster RF., 2005. Compendium of bean diseases. *American Phytopathology Society press*, USA. pp.109.