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Research Progress Analysis of Sclerotinia rot (*Sclerotinia sclerotiorum*) of oilseed Brassicas through Bibliography

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Sclerotinia rot caused by *Sclerotinia sclerotiorum* (Lib.) de Bary is a major disease of oilseed Brassica in the world. Sclerotinia is a ubiquitous, omnivorous, soil-borne phytopathogenic ascomycetes fungus capable of infecting more than 500 plant species of diverse phylogenetic backgrounds including 278 genera in 75 families of dicotyledonous and a significant number of monocotyledonous plants (Purdy, 1979; Willetts and Wong 1980; Steadman, 1983; Boland and Hall, 1994; Saharan and Mehta, 2008, Sharma, 2014). Yield losses vary with the percentage of plants infected, and the growth stage of the crop at the time of infection. Plants infected at the early flowering stage produce little or no seeds, where as those infected at the late flowering stage although will set seeds but suffer little yield reduction.The disease decreases the value of crop by millions of dollars annually through losses in grain yield and quality of seeds (Purdy, 1979).

The pathogen was first described from Belgium by Madame M.A. Libert (1837) as *Peziza sclerotiorum* Libert. (Libert, 1837). G. E. Massee is considered the proper authority for *Sclerotinia sclerotiorum* (Lib.) Massee, because he had first used the binomial in 1895. However, since de Bary used it in his contributions (de Bary *et al.,* 1884; de Bary, 1886), the name and the authority for the fungus has generally been accepted to be *Sclerotinia sclerotiorum* (Lib.) de Bary. This disease is most frequently occur in cool and moist regions (Purdy 1979; Saharan and Mehta, 2008), but has also been reported in some semi-arid regions where conditions seem unfavourable for disease development. It results in damage of the plant tissue, followed by cell death and development of soft rot or white mould (Purdy, 1979).

The present bibliography on Sclerotinia rot (SR) of oilseed Brassica includes 1389 scientific publications, and very carefully and categorically analyses all aspects of research progress during the past 177 years (1837-2014). Our main objective was not only to compile all scientific literature in one publication, but also categorically arrange the bibliography according to centuries and decades, and identify major research areas and leading research institutions. This comprehensive publication, we hope, will help both the present and future researchers in identifying important research publications, leading research institutions and researchers directly related to their field of research. The analysis of SR research progress based on 1389 publications is summarized below:

Century-wise research progress

In the 19th century, 1 per cent publications were recorded on SR (Fig. 2). Twentieth century can be considered a boom period for SR research since 52% papers were published during this century (Fig. 2). Within the first decade of the 21st century, 47 per cent publications were recorded on SR (Fig. 2). Probable reasons for rapid progress of SR research during 20th and 21st centuries seem to be due to awareness of the disease, economic importance causing heavy yield losses, opening of more research institutes, employment of more research personel, improved facilities, knowledge of recently developed biological sciences, availability of more funds, academic interest, interaction of scientists, and development of new fields of biological sciences.

Decade-wise research progress

The number of research papers published on SR

Table 1: Major reviews (monograph), bibliographies, and books published on genus *Sclerotinia*

Authors	**Year**	**Title**	**Name of journal /Institution**	**Vol. & page no.**
de Bary A, de Bary HA and Deutschland B	1884	Vergleichend Morphologie und Biologie der Pilze, Mycetozoen und Bacterien.	Leipzig : Wilhelm Engelmann	525 p.
de Bary A	1886	Ueber einige Sclerotinien und Sclerotien krankheiten	*Botanische Zeitimg*	44:374-474
de Bary A	1887	Comparative morphology and biology of Fungi. (Translated by H E F Garnsey, revised by I B Balfour)	The Clarendon Press, Oxford	525 p.
Whetzel HH	1945	Synopsis of the genera and species of Sclerotiniaceae, a family of somatic inoperculate discomycetes	*Mycologia*	37: 648-714
Ingold CT	1960	Dispersal in Fungi	Clarendon, Oxford	206 p.
Ingold CT	1971	Fungal Spores: their liberation and dispersal	Oxford University Press, London	302 p.
Dumont KP and Korf RP	1971	*Sclerotinia*ceae I. Genetic nomenculature	*Mycologia*	63:157–168
Dumont KP	1971	*Sclerotinia*ceae II. Lambertelia Mem.	*NY Bot Gard*	22: 1–178
Coley-Smith JR and Cooke RC	1971	Survival and germination of fungal sclerotia	*Ann Rev Phytopathology*	9: 65–92
Alabouvette C and Louvet J	1973	*Sclerotinia sclerotiorum*. Bibliographie Sclerotionnee (Dec. 1971)	Inform Tech Centre Tech Interpr of Oleag Metrop	31: 7–26
Chet I and Henis Y	1975	Sclerotial morphogenesis in fungi	*Ann Rev Phytopathology*	13: 169-192
Mordue JEM and Holliday P	1976	*Sclerotinia sclerotiorum* (sclerotial state)	CMI Descriptions of Pathogenic Fungi and Bacteria No. 513.CMI, Kew, Surrey, UK.	
Kohn LM	1979	A monographic revision of the genus *Sclerotinia*	*Mycotaxon*	9:365- 444
Willetts HJ and Wong JAL	1980	The biology of *Sclerotinia sclerotiorum, S. trifoliorum,* and *S. minor* with emphasis on specific nomenclature	*Bot Rev*	46**:** 100–165
Bell AA and Wheeler MH	1986	Biosynthesis and functions of fungal melanins	*Ann Rev Phytopathology*	24: 411–451

Phillips AJL	1987	Carpogenic germination of sclerotia of *Sclerotinia sclerotiorum*: a review	*Phytophylactica*	19: 279–283
Nordin K	1988	*Sclerotinia sclerotiorum* (Lib.) de Bary - a literature review with emphasis on epidemiology and development of forecasting methods for Sclerotinia stem rot.	Växtskyddsrapporter Jordbruk	5: 77
Gladders P, Davies JML and Hardwick NV	1991	Review of *Sclerotinia* epidemic in winter oilseed rape in England and Wales	*Bull OILB/SROP*	16: 1-8
Krüger W	1991	A review on assessment of diseases in oilseed rape - comparison of various methods	*Bulletin SROP*	14: 91-111
Kohn LM	1992	Developing new characters for fungal systematic: An experimental approach for determining the rank of *Sclerotinia*	*Mycologia*	84: 139-153
Willetts HJ and Bullock S	1992	Developmental biology of sclerotia	*Mycol Res*	96: 801–816
Gupta SK and Dohroo NP	1996	Chemical control of *Sclerotinia sclerotiorum* (Lib) de Bary - a review	*Agricul Rev*	17: 75-80
Mordue JEM and Holliday P	1998	*Sclerotinia sclerotiorum*	IMI Descriptions of Fungi and Bacteria. (52) Sheet 513, CABI Bioscience, Bakeham Lane, Egham, Surrey, TW20 9TY, UK.	
Henson JM, Butler MJ and Day AW	1999	The dark side of mycelium; melanins of phytopathogenic fungi	*Ann Rev Phytopathology*	37: 447–471
Glass NL, Jacobson DJ and Shiu PK	2000	The genetics of hyphal fusion and vegetative incompatibility in filamentous ascomycete fungi.	*Ann Rev Genet*	34: 165–186
Thaning C	2000	Ways of managing *Sclerotinia sclerotiorum* inoculum	*Acta Univ Agric Sueciae Agraria*	124 p.
Erental A, Dickman	2008	Sclerotial development in	*Fungal Biol Rev*	22: 6-16

MB and Yarden O		*Sclerotinia sclerotiorum*: awakening molecular analysis of a "Dormant" structure		
Gladdens P, Ginsburg D and Smith JA	2008	Sclerotinia in oilseed rape - a review of the 2007 epidemic in England	*HGCA Project Rep*	433: 44
Singh R, Singh D, Li H, Sivasithamparam S, Yadav NR, Salisbury P and Barbetti MJ	2008	Management of Sclerotinia rot of oilseed Brassicas—a focus on India	*J Oilseed Res*	10: 1–27
Saharan GS and Mehta Naresh	2008	Sclerotinia diseases of crop plants: Biology, ecology and disease management	Springer Science, The Netherlands	485 p.
Sharma Pankaj, Meena PD, Verma PR, Saharan GS, Mehta Naresh, Singh Dhiraj and Kumar A	2014	*Sclerotinia sclerotiorum* (Lib) de Bary causing Sclerotinia rot in oilseed *Brassicas*: A review	*J Oilseed Brassica*	6(S) 1-44p.

during different decades in three centuries are presented in figure 1. Obviously, there was a very slow progress of SR research during the last decade of the 19th century. During the 20th century, rapid progress was made in SR research from 6th to 10th decade. A total of 23 publications were published in the 6th decade which increased to 31 in 7th, 153 in 8th, 224 in 9th, and 276 in the 10th decade. During the 21st century, 412 publications were recorded in the first decade. During the present century more progress is expected because more than 246 papers had already been published from 2010-2014 (Table 2).

Major research areas identified and emphasized

Since its first report in 1837, more than 15 major research areas have been identified and emphasized by the SR researchers during three centuries. Results in Table 3 clearly indicate that maximum attention of scientists has been on 15 major research areas including symptoms, losses, distribution, incidence, survival and ecology (70), mycelium, histopathology, inoculum and morphology (50), infection, pathogenesis and inoculation (73), sclerotia (117), apothecia and ascospore (108), epidemiology and forecasting (63), morphological variability, genetic diversity and mycelial compatibility group (MCG) (67), enzymes, toxins and biochemistry (116), screening and resistance (139), genetics and molecular aspects (69), detection techniques (21), general disease management (94), chemical control (122) followed by mycoparasitism and bio-control (185) and other studies on *S. sclerotiorum* (95). These aspects have been described detail in a recent review on SR by Sharma *et al*., (2014b) and in a book by Saharan and Mehta (2008).

Publication of historical significance

Each year, although several publications are being published on SR in the form of research papers, reviews, book chapters, scientific popular articles, conference proceedings, abstracts of group meetings, workshops, adhoc research scheme reports, key note addresses, and circulars for farmers, all have not been considered worth quoting in this publications of the twenty three

Table 2: Decade-wise research progress during 20th and 21st century

Decade wise	No. of publications	% publications
1900-1909	1	0.07
1910-1919	-	-
1920-1929	3	0.21
1930-1939	4	0.28
1940-1949	10	0.72
1950-1959	23	1.66
1960-1969	31	2.24
1970-1979	153	11.06
1980-1989	224	16.19
1990-1999	276	19.95
2000-2009	412	29.79
2010-2014	246	17.78
Total	**1383**	

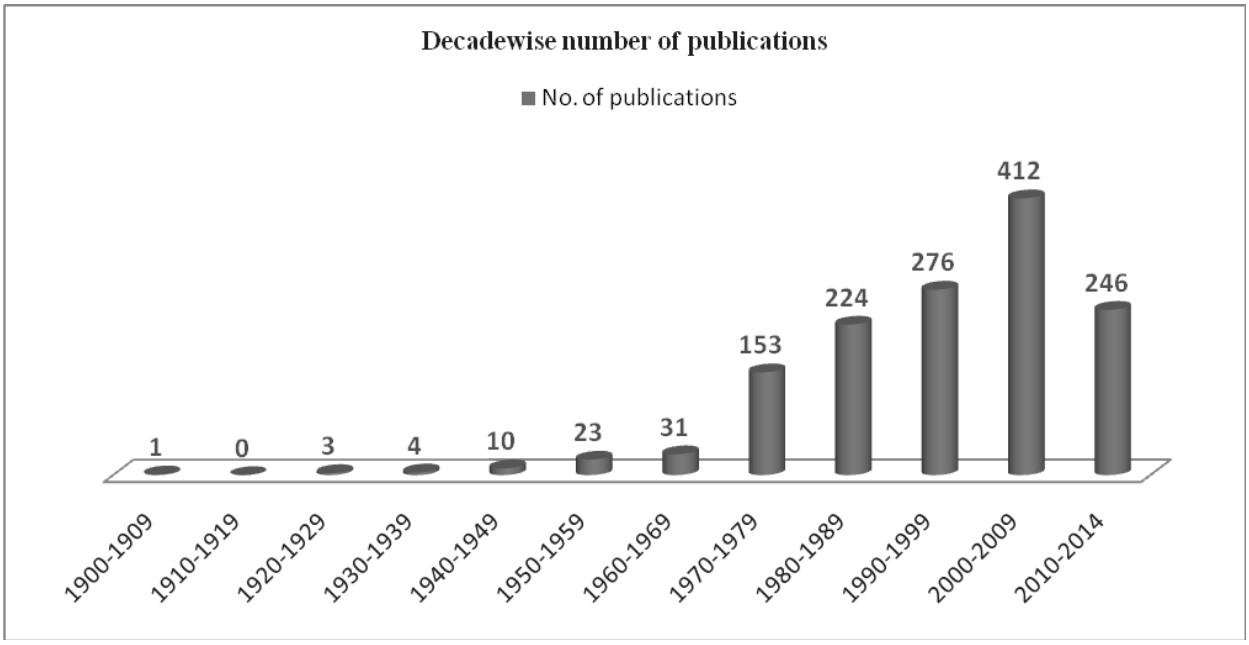

Figure1: Number of research papers published in different decades.

major publications listed in Table 1, 3 were monographs on genus *S. sclerotiorum*, 22 were review papers on fungal melanin, sclerotial development, epidemics, disease assessment and disease management, one bibliography, and six books on *Sclerotinia* and related aspects including the book authored by de Bary. Out of 1389 publications reported so far, some are of classical, conceptual, fundamental, applied, and scientific nature which have helped greatly in SR research developments and comprehension in the following major areas:

Disease symptoms, losses, distribution, incidence, survival ecology and reports of *Sclerotinia sclerotiorum*: (Aghajani *et al.,* 2008; Aggarwal *et al.,*1997; Adams and Ayers, 1979; Anonymous, 2005a,b; Alizadeh *et al.,* 2006; Barari *et al.,* 2000; Chattopadhyay *et al.,* 2005;

Table 3: Major research areas emphasized

S.No.	Major research area	No. of publications	% publications
1.	Disease symptoms, losses, distribution, incidence, survival ecology and reports of *Sclerotinia sclerotiorum*	70	5.03
2.	Mycelium, histopathology, inoculum and morphology of *S. sclerotiorum*	50	3.59
3.	Infection, pathogenesis and inoculation of *S. sclerotiorum*	73	5.25
4.	Sclerotia of *S. sclerotiorum*	117	8.42
5.	Apothecia and ascospore of *S. sclerotiorum*	108	7.77
6.	Epidemiology and forecasting of *S. sclerotiorum*	63	4.53
7.	Morphological variability, genetic diversity and MCG of *S. sclerotiorum*	67	4.82
8.	Enzymes, toxins and biochemistry of *S. sclerotiorum*	116	8.35
9.	Screening and resistance to *S. sclerotiorum*	139	10.0
10.	Genetics and molecular aspects of *S. sclerotiorum*	69	4.96
11.	Detection techniques	21	1.51
12.	Management of *S. sclerotiorum*	94	6.76
13.	Chemical control of *S. sclerotiorum*	122	8.78
14.	Mycoparasitism and bio-control of *S. sclerotiorum*	185	13.31
15.	*S. sclerotiorum:* a study	95	6.83
	Total	**1389**	

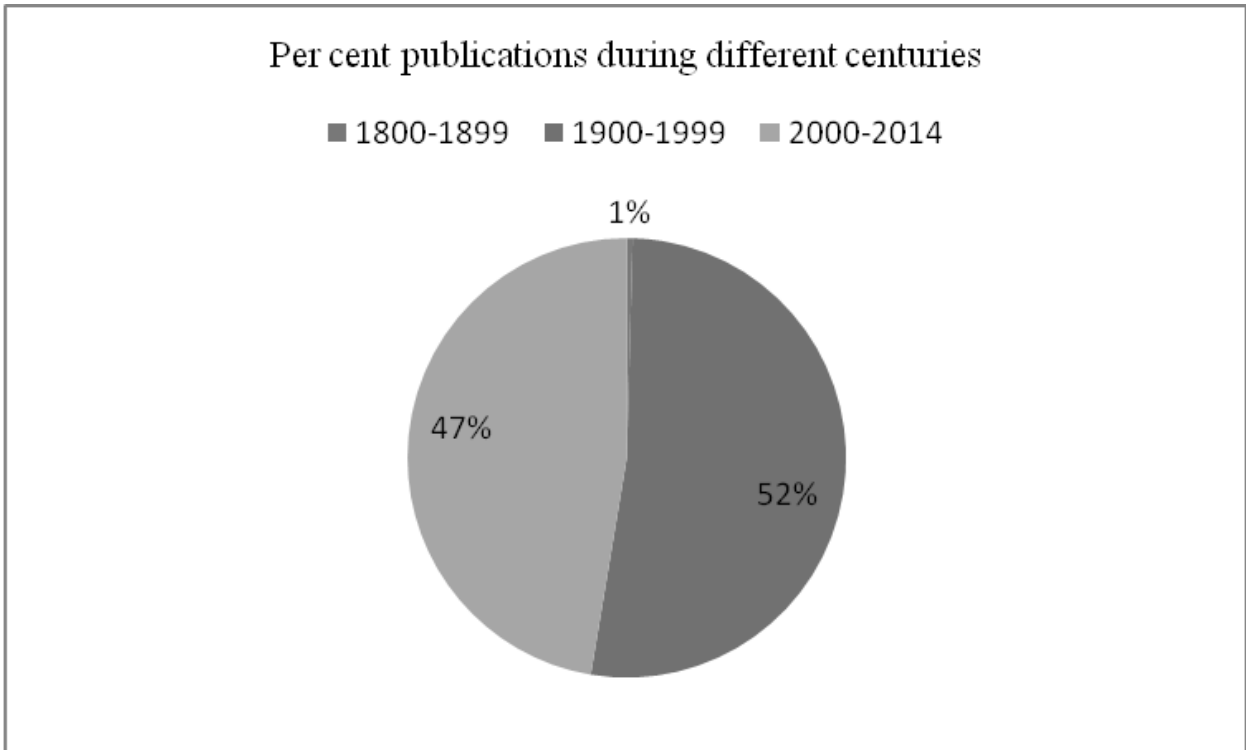

Figure 2 : Percentage of research papers published in different centuries

Chaudhury, 1993; Chauhan *et al.,*1992; Chen and Wu 1990; del Rý´o *et al.,* 2007; Dueck and Sedun, 1983; Dunker and Tiedemann, 2004; Ekins *et al.,* 2002; Franke and Hindorf, 1983; Grogan and Abawi ,1975; Hims, 1979a; Hind-Lanoiselet *et al.,* 2005; Huang and Kozub,1993; Ilumäe *et al.,* 2007; Isakeit *et al.,* 2010; Keay, 1939; Kirkegaard *et al.,* 2006; Kohli,1992; Kohn, 1979; Kruger, 1976a; Lamey *et al.,* 1998; Liu and Sun, 1984; Minuto *et al.,* 2005; Morrall and Dueck, 1983; Nordin and Svensson, 1987; Ono and Kouno, 2007; Poslušná *et al.,* 2013; Roy, 1973; Sansford, 1998; Saxena and Rai, 1987; Sharma, 2014; Sharma and Sharma, 2001; Shimada *et al.,* 2006; Shrestha, 1986; Shukla, 2005b; Singh and Singh, 1986; Takeuchi and Horie, 1996; Tziros *et al.,* 2008; Verma and Morrall,1984; Verma, 1982c; Yadav *et al.,* 2013; Yang, 1959; Young *et al.,* 2012; Zazzerini and Tosi, 1985).

Mycelium, histopathology, inoculum and morphology of *S. sclerotiorum*: (Abawi and Grogan, 1975; Adams and Tate,1976; Calonge, 1970; Carbone *et al.,* 1995; Christias and Lockwood, 1973; de Bary,1887; Ghasolia and Shivpuri, 2009; Goswami *et al.,* 2012; Gugel and Morrall, 1986; Henson *et al.,* 1999; Humpherson-Jones and Cook, 1977b,c; Jones *et al.,* 1974; Jones, 1970; Kohli and Kohn, 1996; Kohn, 1995; Kohli *et al.,* 1995; Kohn *et al.,* 1990; Le Tourneau,1979; Lumsden, 1979; Morrall *et al.,* 1972; Nagy and Fischi, 2002; Qandah and Mendoza, 2012; Purdy,1979; Saito, 1974b; Steadman *et al.,* 1994; Sumida *et al.,* 2014; Tariq and Jeffries,1984; Vakilizarj *et al.,* 2013; Wong and Willetts, 1975,1979; Wu *et al.,* 2008; Ziman *et al.,* 1998; Ziman, 1997).

Infection, pathogenesis and inoculation of *S. sclerotiorum*:(Adams and Ayers, 1983; Baghbanimehmandar *et al.,* 2006; Bashi *et al.,* 2012; Brun and Renard, 1983; Calistru *et al.,* 2013a; Choudhary *et al.,* 2012; Du *et al.,* 2008; Franceschini *et al.,* 1990; Frencel *et al.,* 1998; Garg *et al.,* 2010b,c; Gerlagh *et al.,* 2003; Held and Haenseler,1953; Heran *et al.,* 1999; Huang and Hoes, 1976; Huang *et al.,* 1998; Hung *et al.,* 1998; Jamaux *et al.,* 1995; Jiang, 2001; Jones,1976; Kapoor, 1983; Kreitlow and Sprague, 1951; Li *et al.,* 2007; Li *et al.,* 2008; Li *et al.,* 2005; Liu, 1996; McLean,1958; McCartney *et al.,* 2001a; McLaren *et al.,* 1987; McLaren *et al.,* 1989; McQuilken *et al.,* 1994; Neergaard, 1958; Ni *et al.,* 2014; Newton *et al.,* 1973; Nie *et al.,* 2010; Pandey *et al.,* 2013; Pierre *et al.,*1992; Poussereau *et al.,* 2001a,b; Price and Calhoun, 1975a; Purdy,1958; Rahmanpour *et al.,* 2010, 2011; Rollins, 2003; Scheibert-Bohm *et al.,*1981; Sharma and Meena, 2013; Shi *et al.,* 2013; Singh and Tripathi, 1993; Singh *et al.,*1994a; Singh and Singh,1979; Starzycka and Starzycki, 1997; Thompson and Kondra, 1983; Wang and Tang, 2013; Young and Werner, 2012; Young *et al.,* 2007; Zang *et al.,* 2010).

Sclerotia of *S. sclerotiorum*: (Adams, 1979; Alexander and Stewar, 1994; Anas and Reeleder, 1987; Bacon *et al.,* 1972; Bajoriya *et al.,* 2009; Bakr and Grewal, 1988; Bakr, 1989; Bell and Wheeler,1986; Blum *et al.,* 2002; Börner, 1985; Butler *et al.,* 2009; Calotelo, 1974; Chen and Dickman, 2005; Chen *et al.,* 2004; Chet and Henis, 1975; Coley-Smith and Cooke, 1971; Colotelo, 1973,1974; Diamantopoulou *et al.,* 2000; Dillard *et al.,* 1995; Dimopoulou,1975; Dittmer and Weltzien, 1990; Duan *et al.,* 2013b; Dueck *et al.,* 1981; Duncan *et al.,* 2006; Erental *et al.,* 2008; Ervio *et al.,* 1964; Ethur *et al.,* 2014; Finck and Bome, 1985; Finck, 1989; Fravel *et al.,* 2002; Garcia *et al.,* 2012; Gárriz *et al.,* 2008; Hao *et al.,* 1998; Harada *et al.,* 1974; Harel *et al.,* 2005; Harvey *et al.,* 1995; Hedke and Tiedemann, 1998; Honey, 1928; Huang and Kozub,1991,1993,1994; Huang *et al.,* 1993,1998; Huang, 1981,1982; Humpherson-Jones and Cook,1977; Ivancia, 1992; Kakoti and Saikia, 1997; Khare and Bompeix, 1979; Kim, 1976; Lazarovits *et al.,* 2000; Leiner and Winton, 2006; LeTourneau, 1966,1976; Litkei and Vörös, 1984; Liu and Paul, 2007; Luo *et al.,* 1987; Makkonen and Pohjakallio, 1960; Marukawa and Satamura, 1977; Marukawa *et al.,* 1975a; Melouk *et al.,* 1989; Merriman, 1976; Morrall *et al.,* 1978; Morrall, 1977; Mosa *et al.,* 2000; Nisikado and Hirata, 1937; Pottinger *et al.,* 2008; Prasad and Deb, 1988; Rai and Dhawan,1978; Russo and Van Etten, 1985; Russo *et al.,* 1982; Saito, 1969,1974a,1977; Sansford and Coley-Smith, 1992; Schuhmann, 1975; Sharma *et al.,* 2010; Singh *et al.,* 1995; Singh *et al.,* 1985; Smith and Boland, 1989; Vaughan and Jones, 1979; Wang and LeTourneau, 1972; Weete *et al.,* 1970; Willetts and Bullock, 1992; Zhang *et al.,* 2004).

Apothecia and ascospore of *S. sclerotiorum*: (Achbani *et al.,* 1995; Atkins *et al.,* 2013; Bedi, 1958,1962,1963a,b; Ben-Yephet and Bitton, 1985; Börner,1987; Bourdôt *et al.,* 2001; Bremer *et al.,* 1999; Caesar and Pearson,1983; Casale and Hart,1986; Cerkauskas *et al.,* 1983,1985; Chen *et al.,* 2006; Christiansen, 1966; Clarkson *et al.,* 2003; Codron,1974; Cui *et al.,* 2000; Dickson and Fisher,1923; Duniway *et al.,* 1977; Feng and Thaning, 2001; Garg *et al.,* 2010; Harthill and Underhill, 1976; Henderson,1962a; Henson, 1940; Hirst, 1959; Huang and Erickson, 2004; Huang and Kozub,1989; Hunter *et al.,* 1982; Ingold, 1960,1971; Jayachandran *et al.,* 1987; Jones, 1974; Jones *et al.,* 2004; Kapoor *et al.,* 1987; Kapoor, 1994; Köpmans, 1993; Korf and Willetts, 1975; Kosasih and Willetts, 1975; Krüger, 1975a,1976b,1980a; Lefol and Morrall, 1996; Lefol, 1998; Letham, 1975; Li *et al.,* 1999a; McCartney and Lacey, 1992; McCartney *et al.,* 1999; McLean,1958a; Mila and Yang, 2008; Mitchell and Wheeler, 1990; Mylehreest and Wheeler, 1987; Neto, 1955; Newton and Sequeira, 1972; Olivier and Séguin-Swartz, 2006; Penaud *et al.,* 2012; Phillips, 1987; Purdy, 1956; Qandah and del Río Mendoza, 2011; Radulescu and Crisan,1961; Ratkos, 1982; Reis *et al.,* 2011; Saito, 1973; Schwartz and Steadman, 1978; Sharma and Meena, 2011; Silva *et al.,* 2011; Singh and Singh, 1984; Singh *et al.,* 1995b; Singh and Tripathi, 1996; Singh and Singh, 1987; Singh *et al.,* 1991; Singh and Singh,1983; Steadman and Cook, 1974; Stelfox *et al.,* 1978; Tapke, 1946; Teo and Morrall, 1985a,b; Teo *et al.,* 1985; Terui and Harada,1966; Thaning and Nilsson, 2000; Twengstrom *et al.,* 1998b; Venette *et al.,* 1999; Venturoso *et al.,* 2014; Wang *et al.,* 1996; West *et al.,* 2008; Williams and Stelfox, 1979,1980a,b; Williams *et al.,* 2001; Wu and Subbarao, 2008; Wu *et al.,* 2007).

Epidemiology and forecasting of *S. sclerotiorum*: (Abawi and Grogan,1979; Aghajani *et al.,* 2010; Ahlers, 1986; AICRP-RM, 2009; Boland and Hall, 1987; Bom and Boland, 2000a,b; Buchwald, 1986; Davies *et al.,*1999; Gindrat *et al.,* 2003; Gladdens *et al.,*1991, 2008; Gohari and Ballester, 1991; Gugel and Verma, 1986; Horning, 1983; Huang *et al.,*1998; Ivic´, 2008; Jajor *et al.,* 2010; Koch *et al.,* 2006, 2007; Krüger, 1974,1975b,1987; McCartney *et al.,* 2001b; McDonald and Boland, 2004; McLaren *et al.,* 2004; Mehta, 2014; Milinko *et al.,* 1989; Morrall and Dueck, 1982; Nordin, 1988; Nordin *et al.,* 1992; Sharma *et al.,* 2009b, 2010; Sigvald *et al.,* 1991; Singh and Tripathi, 1998; Singh *et al.,* 2000; Singh and Agrawat,1989; Sun *et al.,* 2010; Torrington *et al.,* 1991; Turkington, 1991; Turkington and Morrall, 1993; Turkington *et al.,* 1988,1991a,b; Turner *et al.,* 2002; Twengström and Sigvald, 1993; Twengstrom *et al.,* 1988a; Twengström, 1996,1999; West *et al.,* 2013; Zhang *et al.,* 1999).

Morphological variability, genetic diversity and MCG of *S. sclerotiorum:* (Anderson and Kohn, 1995; Arbaoui *et al.,* 2008; Atallah *et al.,* 2004; Attanayake *et al.,* 2012,2013; Barari *et al.,*2008, 2010a,b,2011,2012,2014; Barbetti *et al.,* 2014; Basha and Chatterjee, 2007; Boland and Smith, 1991; Carpenter *et al.,* 1999; Chen *et al.,* 2010; Choudhary and Prasad, 2012; Clarkson *et al.,* 2009; Colagar *et al.,* 2010; DRMR, 2009-10,2010-11; Durman *et al.,* 2001,2003; Ford *et al.,* 1999; Ghasolia and Shivpuri, 2007; Glass and Kuldau, 1992; Glass *et al.,* 2000; Goyal *et al.,* 2013; Irani *et al.,* 2011; Irzykowski *et al.,* 2005; Karimi *et al.,* 2011,2012a,b; Kohn *et al.,* 1991; Kohn, 2001; Kull *et al.,* 2000,2004; Leslie, 1993; Li *et al.,* 2000; Ling *et al.,* 2011; Litholdo *et al.,* 2011; Liu *et al.,* 2006; Meinhardt *et al.,* 2002; Mert-Türk *et al.,* 2007; Noonan *et al.,* 1996; Ojaghian and Xie, 2012; Osofee *et al.,* 2005; Price and Colhoun,1975; Purdy,1955; Schafer and Kohn, 2006; Sedun *et al.,*1989; Sexton and Howlett , 2004; Sexton *et al.,* 2006b; Sharma *et al.,* 2009c,2013a; Steadman *et al.,*1998; Sun *et al.,* 2005; Vakilizarj and Rahnama, 2009; Wong and Willetts, 1975; Zandoki *et al.,*2005a,b).

Enzymes, toxins and biochemistry of *S. sclerotiorum*: (Bashi *et al.,* 2010,2013; Bateman and Beer,1965; Cessna *et al.,*2000; Chen *et al.,*2010; Collmer and Keen, 1986; Corsini and Le Tourneau, 1973; Cotton *et al.,* 2002,2003; Cruikshank, 1983; Culbertson *et al.,* 2007; Deena and Kohn, 1995; Dhawan and Srivastava, 1987; Dhawan, 1980a,b,1983; Dixit *et al.,*2012; Dong *et al.,*2008; Duan *et al.,*2014; Durman *et al.,*2005; Dutton and Evans,1996; Echandi and Walker, 1957; Errampalli and Kohn, 1995; Foster *et al.,*2012; Fraisinet-Tachet

and Fevre, 1995, 1996 ; Girard *et al.,*2004; Guo and Stotz, 2010; Guimarães and Stotz, 2004; Harel *et al.,*2006; Hegedus *et al.,*2008; Heller and Witt-Geiges,2013; Huang, 1983b; Huang and Yeung, 2002; Huang *et al.,*2008; Kachroo and Kachroo, 2007; Keets *et al.,*1998; Khare and Bompeix, 1976; Kim *et al.,*2008; Kohn and Korf, 1975; Kolattukudy, 1985; Li *et al.,*1999 a,b,2001,2003,2004, 2004 a; 2008; Liu *et al.,*1997,1998, 2010; Lung *et al.,*1994; Magro *et al.,*1984; Marciano *et al.,*1982; Martel *et al.,*2002; Maxwell, 1973; Overell, 1952; Pedras and Ahiahonu, 2004; Pedras *et al.,*2004, 2010; Penn and Daniel, 2013; Qi *et al.,*2004; Rachim and Nicholas, 1985; Rahmanpour *et al.,*2014; Rai and Dhawan, 1976a,b; Rai *et al.,*1979; Riou *et al.,*1979,1992; Rollins and Dickman, 1998,2001; Rowe, 1993; Sharma *et al.,*2001; Sharma *et al.,*2014b; Starratt *et al.,*2002; Starzycka and Starzycki, 2011; Starzycka *et al.,*2002; Stephen *et al.,*2000; Tariq and Jeffries, 1987; Tariq *et al.,*1985; Thompson *et al.,*1995; Trevethick and Cooke, 1971; Van den Berg and Yang, 1969; Vautard-Mey *et al.,*1999; Vega *et al.,*1970; Waksman *et al.,*1991; Walz *et al.,*2008; Waksman, 1988; Wang and Tourneau, 1973; Watpade and Mehta, 2012,2013; Williams *et al.,*2011; Wong and Willetts,1974; Wu *et al.,*2004; Xu *et al.,*2011; Yadav *et al.,*2012; Yarden *et al.,*2014; Yu *et al.,*1999a,b; Zhang *et al.,*2001; Zhao *et al.,*2006; Zou *et al.,*2006).

Screening and resistance to *S. sclerotiorum:* (Abedi *et al.,*2011; Ahmadifar and Dalil, 2013; Bailey, 1987; Bhandari *et al.,* 2012; Bhela *et al.,* 2009; Blanchette and Auld, 1979; Blinstrubiene *et al.,*2011; Bradley *et al.,*2006; Brun *et al.,*1987; Buchwaldt *et al.,*2003,2005; Chamandoosti and Azad, 2012; Chamandoosti, 2009; Chand and Rai, 2009; Chen *et al.,*2011a; Dalili *et al.,*2002; Dalili, 2013; Dickson *et al.,*1996; Ding *et al.,* 2013; Disi *et al.,* 2014; Eynck *et al.,*2012; Falak *et al.,* 2011; Fan *et al.,* 2013; Fang, 1993; Gao *et al.,*2006; García-Arenal and McDonald, 2003; Garg *et al.,*2008,2010,2013; Ge *et al.,*2012; Goyal *et al.,* 2011; Ghasolia and Shivpuri, 2005; Grison *et al.,*1996; Guan *et al.,*2003; Hao *et al.,*2007; He *et al.,*1987; Hemati *et al.,*2013; Huangfu and Guan, 2010; Jedryczka *et al.,*1996; Ji *et al.,*2006; Jiang *et al.,*1995; Kaczmarek *et al.,*2012; Khot *et al.,*2011; Kunkel and Brooks, 2002; Lefol and Seguin-Swartz,1998; Lefol *et al.,*1997a; Li *et al.,*1999b,2004b,2006,2008; Liu *et al.,*1990,1991, 2001,2003,2005; Liu, 2000; Lu, 2003; Ma *et al.,*2008,2014; McDonald and Linde, 2002; Mei *et al.,* 2012; Miroslava *et al.,*2014; Mondal, 2008; Mullins *et al.,*1995,1999; Navabi *et al.,*2010; Phillips *et al.,*1990; Qian, 2011; Rahmanpour *et al.,*2009; Renard *et al.,*1979; Rimmer *et al.,*2007; Saharan and Mehta, 2008; Sang *et al.,*2013; Scott,1984; Seguin-Swartz and Lefol, 1999; Sharma *et al.,*1995,2001,2009a,2012,2012b; Singh *et al.,*1997; Singh, 2010; Singh *et al.,*2008,2010; Sodhi *et al.,*2004; Starzyck *et al.,*1999,2000,2003; Sweet *et al.,*1992; Tetsuka and Ishida, 2000; Uloth *et al.,*2014; Vitásek, 1994; Wang *et al.,*2003,2004,2010,2014; Watpade *et al.,*2012; Wei *et al.,*2010; Wen,1998; Wulf *et al.,*2010,2013; Yadav *et al.,*2012; Yu *et al.,*2010; Zhang *et al.,*2003,2005; Zhao *et al.,*2003b,2004).

Genetics and molecular aspects of *S. sclerotiorum:* (Boland *et al.,*1993; Boland, 1987,1988,1992; Bolton *et al.,*2006; Butruille *et al.,*1999; Calistru *et al.,*2012a,b,2013b; Carbone and Kohn, 1993,2001; Chitrampalam *et al.,*2010; De Silva *et al.,*2005; Elliston, 1982; Ellouze *et al.,*2011; Errampolli *et al.,*1996; Ferreira *et al.,*1994; Fraissinet-Tachet *et al.,*1996; Ghobakhloo *et al.,*2013; Guo and Stotz, 2007; Hemmati *et al.,*2008; Holst-Jensen *et al.,*1997a,b; Jurick *et al.,*2004; Kheiri *et al.,*2014; Kohn *et al.,*2008; Levy *et al.,*2008; Liang *et al.,*2013; Liu *et al.,*2005a; Melzer *et al.,*2002; Reymond *et al.,*1994; Sasaki *et al.,*2001; Saupe, 2000; Sexton *et al.,*2006a; Shokouhifar *et al.,*2011; Sirjusingh and Kohn, 2001; Song *et al.,*1995; Stotz *et al.,*2011; Teutonico and Osborn, 1994; Toroser *et al.,*2010; Uhm and Fujii, 1986; Uzunova *et al.,*1995; Vacher *et al.,*2003; Wang *et al.,*2011,2012; Wang and Yao, 2013; Weld *et al.,*2005; Wen *et al.,*2013; Xu *et al.,*2009; Yajima *et al.,*2010; Yin *et al.,*2010,2013; Yu *et al.,*2012; Zhang *et al.,*2011; Zhao *et al.,*2009).

Detection techniques: (Chaocai,1995; Duan *et al.,*2014; Ekins *et al.,*2005; Freeman *et al.,*2001,2002; Gindrat and Frei, 2004; Jamaux and Spire,1994; Jurke and Fernando, 2007; Kasza *et al.,*2004; Kumar *et al.,*2013; Morall and Thompson, 1991; Noviello and Korf, 1961; Parker

*et al.,*2014; Prasad *et al.,*2009; Rahnama and VakiliZarj, 2008; Ran *et al.,*2007; Rogers *et al.,*2009; Saur, 1983; Schleier *et al.,*1997; Starzycka *et al.,*1993; Sun, 1995; Wang *et al.,*2010; Yin *et al.,*2009,2010; Young *et al.,*2013).

Management of *S. sclerotiorum*: (Abdou *et al.,*1982; Ahlers, 1989; Budge and Whipps, 2001; Chattopadhyay *et al.,*2002,2004; Du *et al.,*2009; Fernando *et al.,* 2004; Ferraz *et al.,* 2003; Fu and Tang, 1994; Gladders *et al.,*2008,2011; Gracia-Garza *et al.,*2002; Gu *et al.,*2012; Gupta *et al.,*2004b; Hieu, 2007; Hind-Lanoiselet and Lewington, 2004; Huang and Huang, 1993; Huang and Sun, 1991; Huang *et al.,*1997,2002,2006,2007; Jurke and Fernando, 2002,2006; Jurke *et al.,*1998; Kharbanda and Tewari, 1996; Klasse, 1993; Korbas and Wegorek, 2006; Kruger and Stoltenberg, 1983; Kruger, 1973,1983; Kutcher and Malhi, 2010; Letham *et al.,*1978; Lumsden *et al.,*1983; Meena *et al.,*2005,2006,2011,2014; Mehta *et al.,* 2009, 2010b, 2011; Milléo and Lima,1997; Milléo *et al.,*2000; Monteiro *et al.,*2012; Prasad and Kumar, 2007; Prasad *et al.,*2009; Quentin, 2004; Regnault and Pierre, 1984; Ren *et al.,*2013; Roy and Saikia, 1976; Sharma and Meena, 2012a; Singh *et al.,*2008; Singh, 2001; Souliac and Leroux, 1995; Steadman,1979; Swaminathan,1999; Tripathi and Tripathi, 2009; Tripathi *et al.,*2010; Turkington *et al.,*2011; Verma, 1982a; Volotovich, 2005; Wahmhoff *et al.,*1999; Yadav *et al.,*2011,2012; Yadav, 2004; Yu *et al.,*1995).

Chemical control of *S. sclerotiorum:* (Berkenkamp and Friesen, 1973; Brachaczek *et al.,*2012; Bradley *et al.,*2006; Chand *et al.,*2009; Chaudhary *et al.,*2010; Chen *et al.,*2011b; Costa *et al.,*2004; Davies and Muncey, 2004; Dhawan,1980c; Duan *et al.,*2012,2013a; Dueck *et al.,*1983; Fillot *et al.,*2006; Freer *et al.,*2011; Garcia *et al.,*2013; Gindrat, 1993; Gladders *et al.,*2011; Gossen *et al.,*2001; Gullino *et al.,*1998*;* Gupta and Dohroo, 1996; Hara and Yanagita, 1967; Hawthorne and Jarvis,1973; Hsiang *et al.,*1998; Jackson and Smith, 1979; Jones, 1974; Kaczmar *et al.,*2000; Koch, 2010; Kuang *et al.,*2011; Kurt *et al.,* 2011; Kutcher and Wolf, 2006; Li *et al.,*2007; Liu *et al.,*2009; Ma *et al.,* 2009a,b; McKenzie and Verma,1992a,b; McKenzie *et al.,*1988,1989; Mehta *et al.,*2010a; Moinard *et al.,*2009; Morrall and Verma, 1987,1988; Morrall *et al.,*1983,1984a,b,1985,1989; Naito and Tani, 1952; Pan *et al.*1997a,b,2000; Pan, 1998; Paul and Beineke, 1993; Pelmus *et al.,*1988; Penaud *et al.,*2013; Qi *et al.,* 2011; Qin *et al.,*2011; Ren *et al.,*2010; Ritchie *et al.,*2013; Sharma and Kapoor, 1998; Sharma *et al.,*2011; Shen, 1992; Shi *et al.,*2000a,b; Shivpuri and Gupta, 2001; Singh and Kapoor, 1996; Singh *et al.,*1994b,2003; Singh, 1998; Spitzer *et al.,*2012; Stiers *et al.,*1980; Terhardt and Johnen, 2012; Thompson *et al.,*1984; Thwin and Mitchell, 1990; Tripathi *et al.,*2010; Twengström, 1996; Verma and McKenzie, 1982; Verma and Morrall, 1987; Verma *et al.,*1983,1985,1986,1987; Verma, 1984; Vozenílková and Sbornik,1996; Wang *et al.,*2009; Xie *et al.,*1999; Yarden *et al.,*1986; Zewain *et al.,*2004).

Mycoparasitism and bio-control of *S. sclerotiorum:* (Adams *et al.,*1985; Adams, 1989; Aeron *et al.,*2011; Aertsens and Michi, 2004; Akbari *et al.,*2005; Akrami *et al.,*2008; Aksay *et al.,*1991; Ayers and Adams,1979a,b,1981,1983; Ayers *et al.,*1981; Bae and Knudsen, 2007; Baharlouei *et al.,*2011; Bennett *et al.,*2006; Boland and Inglis, 1989; Budge *et al.,*1995; Campbell,1947; Carisse, 2001; Chaban *et al.,*1993; Chattopadhyay *et al.,*2007; Cook and Bake,1983; Das *et al.,*2002; Dos Santos and Dhingra,1982; Ethur *et al.,*2001; Fernando *et al.,*2007a,b; Fravel, 1998; Gao *et al.,*2013; Gerlagh *et al.,*1995a,b,1999; Ghaffer, 1972,1988; Gracia-Garza *et al.,*1997a,b; Han *et al.,*2012; Hicks *et al.,*2011; Hu *et al.,*2005,2010,2013; Huang and Erickson,2007,2008; Huang and Kokko, 1987,1988,1993; Huang, 1978; Huang , 1992; Hubbard *et al.,*1982; Hutchins and Archer, 1994; Inbar *et al.,*1996; Jones and Watson, 1969; Jones and Stewart, 2011; Jones *et al.,*2011; Knudsen *et al.,*1991; Kumar *et al.,*2012; Kumar and Sharma, 2012; Lee and Wu, 1979; Li *et al.,*2002, 2003a,2005,2006,2013; Litkei, 1988; Luth *et al.,*1993; Madsen and Neergaard, 1999; Martinson and del Rio, 2001; Matroudi *et al.,*2009; McCredie and Sivasithamparam, 1985; McQuilken *et al.,*1995, 2003; Meena *et al.,*2009, 2014; Mehta and Hieu, 2014; Mehta *et al.,*2012; Melo *et al.,*2006,2011; Mónaco *et al.,*1998; Morandi *et al.,*2012; Nelson *et al.,*2001; Parfitt *et al.,*1983; Pathak *et al.,*2001;

Phillips and Price, 1983; Phillips, 1986a; Reeleder, 2004; Rodriguez and Godeas, 2001; Savchuk and Fernando, 2001,2002,2004; Savchuk *et al.,*2003; Selin *et al.,*2010; Sharma and Basandrai, 1997; Sharma *et al.,*1992; Shi *et al.,*2004; Shivpuri *et al.,*2009; Singh, 1991; Singh and Kaur, 2001; Singh, 1998; Smith, 1972; Srinivasan *et al.,*2001; Stadler *et al.,*2013; Steindorff *et al.,*2014; Teo *et al.,*1992; Tribe, 1957; Trutmann *et al.,*1982; Tuncer and Damdere,1997; Turner and Tribe,1976; Voros, 1969; Watson and Miltimore, 1975; Weber, 2002; Whipps and Gerlagh,1992; Wu, 1988; Yang *et al.,*2007,2011; Zazzerini and Tosi, 1985; Zeng *et al.,*2012; Zhang *et al.,*2004a,b,2009; Zhang, 2004; Zhu and Chen, 2010).

Study on *S. sclerotiorum:* (Alabouvette and Louvet, 1973; Ale-Agha, 1974; Boland and Hall, 1994; Bradley and Lamey, 2005; Buchwald and Neergaard, 1973; Buchwald,1947,1949; Chattopadhyay *et al.,*2003; de Bary,1884; de Bary, 1886; Dennis,1974; Dickman and Mitra,1992; Dickson, 1930; Duczek and Morrall, 1971; Dueck, 1977; Dumont and Korf, 1971; Dumont, 1971; Ferreira and Boley, 2002; Ghasolia *et al.,*2004; Granér, 2002; Hegedus and Rimmer, 2005; Ivancia, 1993; Kohn, 1979,1992; Korf and Dumont, 1972; Korf, 1973; Libert, 1837; Liu, 1996; Miller *et al.,*1987,1989; Mordue and Holliday, 1976,1998; Morrall *et al.,*1976; Nordin, 1986; Rachim and Nicholas, 1986; Saha *et al.,*1988; Saharan and Mehta, 2002,2008; Saharan *et al.,*1981,2005; Saharan,1992; Sharma *et al.,*2014a,c; Shivpuri *et al.,*2000,2001; Sprague and Stewart-Wade, 2002; Starzycka and Starzycki, 2008; Su and Leu, 1980; Tariq, 1984; Thomas, 1984; Verma, 1982b; Wakefield, 1924; Wallace,1944; Whetzel, 1945; Williams, 1981; Woronin, 1888; Zhao *et al.,*2010; Ziman *et al.,*1999).

Table 4: Leading institutions involved in research on *Sclerotinia sclerotiorum* of oilseed Brassica in the world

S.N.	Name of Institute	Country
1.	Cátedra de Microbiología Agrícola/INBA (CONICET/UBA), Universidad de Buenos Aires, Buenos Aires	Argentina
2.	Universidad Nacional del Sur, 8000 Bahía Blanca	Argentina
3.	University of New England, Armidale	Australia
4.	The University of Western Australia, 35 Stirling Highway, Crawley, WA 6009	Australia
5.	Charles Sturt University, Wagga Wagga, NSW 2678	Australia
6.	ISK Biosciences Europe N.V., Diegem	Belgium
7.	Universidade Federal de Viçosa, 36570-000, Viçosa, MG	Brazil
8.	Universidade Federal da Grande Dourados, UFGD, Dourados, MS	Brazil
9.	Universidade Federal de Goiás-UFG, Goiânia, GO	Brazil
10.	Universidade Estadual de Ponta Grossa	Brazil
11.	Agriculture and Agri-Food Canada, 107 Science Place, Saskatoon, SK S7N 0X2	Canada
12.	Agriculture and Agri-Food Canada, Lethbridge Research Centre, 5403-1st Ave. S, PO Box 3000, Lethbridge, Alberta T1J 4B1	Canada
13.	University of Alberta, Edmonton, AB T6G 2P5	Canada
14.	University of Saskatchewan, 110 Science Place, Saskatoon, SK S7N 5C9	Canada
15.	University of Manitoba, Winnipeg, MB R3T 2N2	Canada
16.	Agriculture and Agri-Food Canada, P.O. Box 1240, Melfort, Saskatchewan, S0E 1A0	Canada
17.	University of Guelph, Guelph, ON N1G 2W1	Canada
18.	Nanjing Agricultural University, Nanjing 210095	China
19.	Southwest University, Chongqing 400716	China
20.	Huazhong Agricultural University, Wuhan 430070	China
21.	Nanjing Agricultural University, Nanjing 210095	China
22.	The Oil Crops Institute/National Oil Crops Improvement Center, Changsha, Hunan, 410128	China

23.	Oil Crops Research Institute, Chinese Academy of Agricultural Sciences, Wuhan 430062	China
24.	Guizhou Institute of Oil Crops, Guiyang, Guizhou 550006	China
25.	Anhui Agricultural University, Hefei 230036	China
26.	South China Normal University, Guangzhou 510631	China
27.	Northwest A & F University, Yangling, Shaanxi 712100	China
28.	Longyan University, Longyan 364000	China
29.	Jiangsu University, Zhenjiang 212013	China
30.	Yangzhou University, Yangzhou 225009	China
31.	Dalian Institute of Chemical Physics, Chinese Academy of Sciences, Dalian 116023	China
32.	Yangtze University, Jingzhou, Hubei Province 434025	China
33.	Zhenjiang Institute of Agricultural Science in Hilly Area of Jiangsu Province, Jurong 212400	China
34.	Longyan University, Longyan, Fujian 364000	China
35.	Zhejiang University, Hangzhou 310058	China
36.	Shanghai Normal University, Shanghai 200234	China
37.	Crops Research Institute, Jiangxi Academy of Agricultural Sciences, Nanchang 330200	China
38.	Zhejiang University of Technology, 18# Chaowang Road, Hangzhou 310032	China
39.	National Research Center of Rapeseed Engineering and Technology, Huazhong Agricultural University, Wuhan 430070	China
40.	Zhengzhou University, Zhengzhou 450001	China
41.	Industrial Crops Research Institute, Henan Academy of Agricultural Sciences, Zhengzhou 450002	China
42.	Hunan Agricultural University, Changsha 410128	China
43.	Agricultural Sciences Research Institute of Yichun City, Jiangxi Province, Yichun 336000	China
44.	Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, Beijing 100081	China
45.	Sichuan University, Chengdu 610064	China
46.	Poljoprivredni fakultet u Osijeku, Kralja Petra Svaèic´a 1d, 31000 Osijek	Croatia
47.	Department of Phytopathology, Svetošimunska 25, 10000 Zagreb	Croatia
48.	Academy of Sciences of the Czech Republic, Rozvojová 313, 165 02 Prague	Czech Republic
49.	Agrotest fyto, Ltd. s.r.o., Havlíèkova 2787/121, 767 01 Kromeríz	Czech Republic
50.	Svaz pestitelu a zpracovatelu olejnin, Na Fabiánce 146, 182 00 Praha 8	Czech Republic
51.	Afd. for Plantepatologi Planteværnscentret, Lottenborgvej 2, 2800 Lyngby	Denmark
52.	CETIOM, Direction Technique - Pathologie végétale, Campus de Grignon, Av. L. Brétignières, FR - 78850 Thiverval-Grignon	France
53.	DuPont Solutions, Défense Plaza, 23/25 rue Delarivière Lefoullon, F-92800 Puteaux	France
54.	DRAAF-SRAL Midi-Pyrénées, Bd Armand Duportal, 31074 Toulouse Cedex	France
55.	Unité de Phytotechnologie, Sanofi Recherche, Centre de Labège, F-31676 Labège Cedex	France
56.	BASF Agro SAS, 21 Chemin de la Sauvegarde, F-69134 Ecully Cedex	France
57.	INRA, UMR 211 INRA AgroParisTech, 78850 Thiverval-Grignon	France
58.	Georg-August-University of Göttingen, Grisebachstr 6, D-37077 Göttingen	Germany
59.	Dienstleistungszentrum Ländlicher Raum, Westerwald-Osteifel, Montabaur	Germany
60.	Prophyta GmbH, Inselstrasse 12, 23999 Malchow	Germany
61.	Feinchemie Schwebda GmbH, Eschwege	Germany
62.	Du Pont de Nemours (Deutschland) GmbH, Neu-Isenburg	Germany
63.	Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie, Freiberg	Germany

64.	Christian-Albrechts-Universität of Kiel, Hermann, Rodewald Str. 9, D-24118 Kiel	Germany
65.	Julius Kühn-Institut, Braunschweig	Germany
66.	Inst. Pflanzenbau Pflanzenzuchtung, Giessen	Germany
67.	Universität-GH-Paderborn, Labor für Biotechnologie und Qualitätssicherung, Lübecker Ring 2, D-59494 Soest	Germany
68.	National Institute for Agricultural Quality Control, Budapest	Hungary
69.	ICAR-Directorate of Rapeseed-Mustard Research (ICAR),Sewar, Bharatpur 321 303	India
70.	ICAR-Indian Agricultural Research Institute, Pusa, New Delhi 110 012	India
71.	CCS Haryana Agricultural University, Hisar - 125 004	India
72.	Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut 250 110	India
73.	GB Pant University of Agriculture and Technology, Pantnagar 263 145	India
74.	ICAR-National Centre for Integrated Pest Management, Pusa Campus, New Delhi 110 012	India
75.	Gurukul Kangri University, Haridwar, 249 404	India
76.	SK Rajasthan Agricultural University, Sriganganagar 335 001	India
77.	CSA University of Agriculture and Technology, Kanpur 208 002	India
78.	Rajendra Agricultural University Dholi, Muzaffarpur 848125	India
79.	SKN Agriculture University,Jobner, Jaipur 302 029	India
80.	ND University of Agri. & Tech., Kumarganj, Faizabad 224 229	India
81.	Assam Agricultural University, Shillongani, Assam 782 001	India
82.	Banaras Hindu University, Varanasi 221 005	India
83.	CSK Himachal Pradesh krishi Vishwavidyalaya, Kangra, Palampur 176 001	India
84.	Indira Gandhi Agricultural University, Jagdalpur 494 005	India
85.	Pulses and oilseeds Research Station, Berhampore 742 101	India
86.	RVRS Agricultural University, Morena 476 001	India
87.	University of Delhi, South campus, New Delhi 110 021	India
88.	Uttar Banga Krishi Viswavidyalaya Majhian, Patiram, Dakshin Dinajpur733 133	India
89.	Punjab Agricultural University, Ludhiana 141 004	India
90.	Urmia University, Urmia	Iran
91.	Islamic Azad University, Tehran	Iran
92.	University of Tehran, Karaj, Tehran	Iran
93.	Agricultural and Natural Resources University of Sari, Mazandaran	Iran
94.	University of Zanjan, Zanjan	Iran
95.	Gorgan Univ. of Agricultural Sciences and Natural Resources, Gorgan	Iran
96.	Iranian Research Institute of Plant Protection, Tehran	Iran
97.	National Institute of Genetic Engineering and Biotechnology, P.O. Box 14965/161, Tehran	Iran
98.	Tarbiat Modares University, Tehran	Iran
99.	University of Mazandaran, Babolsar, 47416-95447	Iran
100.	University College, Cork,	Irish Republic
101.	Hebrew University, Jerusalem, Rehovot 76100,	Israel
102.	CRA CAT, Unità di ricerca per le Colture Alternative al Tabacco, via Vitiello 108, Scafati (SA)	Italy
103.	ENEA, Divisione Biotecnologie e Agricoltura, Centro Ricerche Trisaia, Rotondella (MT)	Italy
104.	Hirosaki University	Japan
105.	Tottori Daisen Agricultural Extension Service Station, 541-8 Daisen-cho, Saihaku-gun, Tottori 689-3303	Japan

106.	Tokyo Metropolitan Agriculture and Forestry Research Center, Chichijima, Ogasawara-mura, Tokyo 100-2101	Japan
107.	Latvia University of Agriculture, Liela Street 2, Jelgava, LV 3001	Latvia
108.	Lithuanian University of Agriculture, Studentu 9, LT-53361 Akademija, Kaunas District	Lithuania
109.	Lincoln University, Lincoln 7647	New Zealand
110.	Uniwersytet Przyrodniczy we Wroc³awiu, Katedra Ochrony Roœlin, Pl. Grunwaldzki 24A, 50-363 Wroc³aw	Poland
111.	Instytut Genetyki Roœlin Polskiej Akademii Nauk w Poznaniu, Poznan	Poland
112.	DuPont Poland Sp. z o.o., Postepu 17b, 02-676 Warszawa	Poland
113.	Uniwersytet Warmin´sko-Mazurski w Olsztynie 1 Katedra Fitopatologii i Entomologii Prawochen´skiego 17, 10-720 Olsztyn	Poland
114.	National Research Institute, Research Division in Poznan´, ul. Strzeszyn´ska 36, 60-479 Poznan´	Poland
115.	Stacja Doœwiadczalna Oceny Odmian, Kreczunowicza 13, 62-811 Koœcielna Wieœ	Poland
116.	Instytut Ochrony Roœlin, Pan´stwowy Instytut Badawczy, Wladyslawa Wegorka 20, 60-318 Poznan´	Poland
117.	Technical-Agricultural University, Bydgoszcz	Poland
118.	University of Bucharest, 1-3 Portocalelor Alley, RO-060101 Bucharest 35	Romania
119.	University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Maras'ti Blvd., District 1, 011464 Bucharest	Romania
120.	University of Agricultural Sciences and Veterinary Medicine of Ias'i, Ias'i	Romania
121.	Banat's University of Agricultural Sciences and Veterinary Medicine, Timisoara, Aradului Street, No. 119, RO-300645	Romania
122.	Slovak Academy of Sciences, Nádrazná 52, SK-90028 Ivanka pri Dunaji	Slovakia
123.	North-West University, Potchefstroom Campus, Private Bag X6001, Potchefstroom 2520	South Africa
124.	Stellenbosch University, Stellenbosch	South Africa
125.	Department of Plant Biology, SLU, Box 7080, SE-750 07 Uppsala	Sweden
126.	Agroscope RAC Changins, case postale 254, CH-1260 Nyon 1	Switzerland
127.	Mustafa Kemal University, 31034 Antakya-Hatay	Turkey
128.	Central Science Laboratory, Sand Hutton, York, Y041 1LZ	UK
129.	ADAS Boxworth, Boxworth, Cambridge, CB23 4NN	UK
130.	NIAB TAG, Winchester, Hampshire S021 3NE	UK
131.	Rothamsted Research, Harpenden, Herts AL5 2JQ	UK
132.	ADAS Drayton, Defra Drayton, Alcester Rd., Stratford on Avon, Warwickshire CV37 9RQ	UK
133.	Washington State University, Pullman, WA 99164	USA
134.	University of Florida, Quincy, Florida	USA
135.	Monsanto Corporation, Spencer, IA 51301	USA
136.	North Dakota State University, Fargo, ND 58108	USA
137.	Texas A&M University, College Station, TX 77843	USA
138.	University of Georgia, Griffin Campus, Griffin, GA 30223	USA
139.	University of Alaska Fairbanks, Palmer, AK 99645	USA
140.	A DuPont Company, 7300 NW 62nd Avenue, P.O. Box 1004, Johnston, IA 50131	USA
141.	New York State Agricultural Experiment Station, 630 W. North St., Geneva, NY 14456	USA
142.	FONAIAP Experimental Station El Cuji, Barquisimeto	Venezuela

Future Thurst Areas of Research

S. sclerotiorum is a major challenge faced by plant pathologists. Management is difficult, inconsistent and uneconomical due to the presence of wide host range and long-term survival of the resting structures. Biotechnological methods viz., gene transfer, *Agrobacterium tumefaciences*-mediated transformation, protoplast culture, somatic hybridization and microplast techniques should be exploited for developing transgenic plants of crops with superior resistance to *Sclerotinia.* Several strategies including detoxification defense, activation and general inhibition have potential to engineer *Sclerotinia* resistance. It is essential to understand disease epidemic in variable environmental conditions. The integrated disease management strategy including cultural, chemical, biological and host resisitance should be refined, retested and revalidated under changing environmental conditions. Most future research should be concentrated on the disease management and development of resistant/tolerant varieties as follows:

i. Effect of weather on different stages of pathogen/ pathogenesis/ disease cycle.

ii. Development of precise and quick diagnostic tools.

iii. Monitoring of occurrence, distribution and severity of disease.

iv. Analyses of host-pathogen-environment interaction for developing disease forecasting models.

v. Development of simple and functional disease forecasting models.

vi. Use of Information Technology (IT) to manage, storage, processing, analysis and presentation of data.

vii. Dissemination of disease management technology.

viii. Identification of multiple disease resistant sources.

ix. Analysis of genetic diversity in populations of host and pathogen.

x. Induced resistance and systemically acquired resistance (SAR).

xi. Identification of disease tolerance and partial resistance genes.

xii. Genetics of virulence and virulence spectrum.

xiii. Best use of IPM and IDM technology.

xiv. Coordination/cooperation/interaction with other researchers including plant breeders, statistician, soil scientist and institutions.

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