REVIEW ARTICLE

Significance and Management of Chickpea Wilt/root rot and Future Prospects in Ethiopia. A Review

Asrat Z

Ethiopian Institute of Agricultural Research, Debre Zeit Center, P.O. Box 32, Debre Zeit, Ethiopia
Email: asratzew@gmail.com

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ABSTRACT

Chickpea production and productivity in Ethiopia has recently declined and high potential yield gaps because of several abiotic and biotic factors. The average chickpea yield in Ethiopia is usually below 2 t/ha although its potential yield is more than 5 t/ha. It is resulted from susceptibility of chickpea landraces to heat stress, terminal drought, water-logging and poor cultural practices. One of the greatest biotic stress reducing potential yields in chickpea is chickpea wilt/root rot caused by *Fusarium oxysporum* f.sp. *ciceris* which is serious problem especially in the rain fed area. The diseases were more prevalent in most of North western and Central Ethiopia and high disease incidence was found on local than improved variety. Fusarium wilt is both seed and soil borne disease. In Ethiopia, about 30% yield loss of chickpea due to chickpea wilt has been reported. The wilt root rot caused yield loss of 50–80% in some farmers' fields and sometimes even 100% loss on local variety. The fungus can survive in soil as means of chlamydospore and in chickpea debris. The pathogen only pathogenic to chickpea and another legume and weed species also serve as symptomless carrier. Spores can be moved short distance through rain splash, wind, water moving and farm machinery to surrounding plants and transported over large distance in infected seed in to new area. There was four race of pathogenic variability were well known in the country. Chickpea wilt/root rot controlled through use of resistant cultivar is most cost effective and practicable approach. The integrated management strategies like resistant cultivar, bed preparation, sowing time, soil-solirazation, bio-control, bio-fumigants and chemical treatments best approach to reduce the incidence of the wilt/root rot of chickpea and optimization of the yields. Therefore, the further studies of pathogen races, development of other management methods and verification of available methods need focus and encouragements on production of bio control agents as components of integrated disease management. In these paper, available management and epidemiology wilt/root rot disease were reviewed in chickpeas in Ethiopia.

Key words: Chickpea, wilt root rot, disease management, resistance, bio control, variability

1. INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the second most important cool season food legume crop after common bean (*Phaseolus vulgaris* L.) followed by field pea (*Pisum sativum*) and third in production worldwide (Diapari *et al.,* 2014). Currently, one of the widely cultivated crops at the global level on 13.5 million hectares of area with 13.1 million tons of grain legume is produced (FAOSTAT, 2014).

Primarily, chickpeas are grown in the Indian, Turkey, Pakistan, Iran, Myanmar, Ethiopia, Mexico, Australia, Syria, Spain, and Canadian (Guar *et al*., 2012). India is the leading chickpea producing country with 67.4% of world chickpea production (FAOSTAT, 2014). Ethiopia shares 2% among the most chickpea producing countries next to India (73.3%), Turkey (8%) and Pakistan (7.3%).

Ethiopia is secondary center of genetic diversity for chickpea and the wild relative of cultivated chickpea, *Cicer cuneatum* is found in Tigray region of Ethiopia (Yadeta and Geletu, 2002). Debre Zeit agricultural research center (DZARC) is the premier institute for chickpea research in Ethiopia.

It is an important source of human food and animal feed and grown in many parts of the world (Millan *et al*. 2006). Chickpea returns significant amount nitrogen to soil and fertility and breaking the disease cycles of important cereal pathogen (Pande *et al*. 2011) and for this main reason used in rotation with several cereals like tef on heavy soils (Geletu and Yadeta, 1994).

An average chickpea yield in Ethiopia is usually below 2ton/ha although its' potential yield is more than 5ton/ha (Melese, 2005). A number of abiotic and biotic factors are responsible for its high yield gaps. This is resulted from susceptibility of landraces to terminal drought, heat and no protection against weeds, diseases and insect pests (Asfaw *et al.* 1994). Although, more than 70 pathogens have been reported so far on chickpea from different parts of world and a few of them are currently recognized as significantly important to chickpea production (Pande *et al.* 2010).

One of the greatest biotic stress reducing potential yields in chickpea is chickpea wilt caused by *Fusarium oxysporum* f.sp *ciceris* causing is a serious problem especially in the rain fed area. Is one of the major asexual soil or seed borne disease of chickpea worldwide (Jalali and Chand, 1992).

2. CHICKPEA PRODUCTION IN ETHIOPIA

It is cultivated mainly in crop-livestock based farming systems of the Central, North and Northwest highlands of Ethiopia where Verti soils are dominating. Chickpea is mainly grown in Amhara (52.5%), Oromia (40.5%), SNNP (3.5%) and Tigray (3%) (CSA, 2016).

In Ethiopia, chickpea is cultivated at an altitude ranging from 1400 to 2300 meters above sea level (m.a.s.l.) and with annual rainfall ranging from 700 to 2000 mm on Verti soils with a range of pH 6.4-7.9. The crop mainly grows under residual moisture at the end of the main rainy season in water-logging areas. Chickpea is a less labor-intensive crop and its production demands low external inputs compared to cereals (Bekele *et al*. 2007).

Over 1.86 million farmers are engaged in producing chickpea and lentils. The total area covered by chickpea in Ethiopia is estimated at 258,486.29ha and from which annual production of 472,611.39 tons of chickpea grain is produced (CSA, 2016). Ethiopian chickpea production is predominated by Desi type chickpea (about 95%). However, in recent years there has been an increase in the interest of farmers in growing large seeded Kabuli varieties due to their higher price in the market (Guar *et al*. 2005).

However, there has been a substantial export of chickpea by Ethiopia during the past five years, with the highest of 48,549 tons (valued at US$14.7 million). Ethiopia is the largest producer of chickpea in Africa accounting for about 46% of the continent's production (Joshi *et al*. 2001).

3. SIGNIFICANCE OF CHICKPEA WILT/ROOT ROT

Chickpea wilt/root rot is widely distributed in 32 countries causing severe losses in yield. It is one of the severe disease causes heavy loss (20-100%) depending up on stage of infection and wilting (Nene *et al*. 1996).

Throughout the world, annual chickpea yield losses due to Fusarium wilt vary from 10 to 50% every year (Trapero-Casas and Jimenez-Diaz, 1985) but can reach even 100% under certain conditions. Yield losses of chickpea due to Fusarium wilt are estimated at 10% in

India and Spain, 40% in Tunisia, 17% in Iran (Karimi *et al*. 2012).

In Ethiopia, about 30% yield loss of chickpea due to chickpea wilt has been reported, where *F. oxysporum* f. sp. *ciceris* was isolated from more than 50% of the root samples (Meki *et al*. 2008). On the basis of surveys made in Shewa region between 1986 and 1992, a yield loss of about 30% was estimated to have occurred due to wilt/root rots on chickpea in farmers' fields (Mengistu and Negussie, 1994). According to Geletu *et al*. (1996) the disease caused yield loss of 50–80% in some farmers' fields. In addition to yield reduction, it also adversely affected the quality of grains by shrivelling the seed.

3.1. Morphology of pathogen

They are thin-walled and 2-5 septate while microconidia are kidney shaped and occur on short micro conidiophores. Chlamydospores are thick-walled and are produced in hyphae or conidia. Fusarium taxonomy has been based on morphological characteristics of the anamorph including the size and shape of macro conidia, the presence or absence of micro conidia and chlamydospores, colony colour and conidiophore structure (Gupta, 1986).

When grown in culture, *F. oxysporum* initially produces colorless to pale yellow mycelium that turns pink or purple with age and it has no known sexual stage. Van der Maesen (1987) described *Fusarium oxysporum* as having a whitish mycelium with a red-pigmented, ovoid micro conidia and spindle-shaped, septate macro conidia.

Symptom type has been used to subdivide *F. oxysporum* f. sp. *ciceris* into two pathotypes (Trapero-Casas & Jiménez-Díaz, 1985), designated wilting and yellowing pathotype. Pathotypes are assigned to pathogenic races according to variation in virulence. Races can be defined by differential disease reaction on chickpea host genotypes. For *F. oxysporum* f. sp. *ciceris*, eight races with distinct geographic distributions have been identified.

3.2. Pathogen biology and ecology

The fungus can survive in soil and chickpea debris by means of chlamydospores for at least 6 years (Haware *et al*. 1996) but infection of symptomless dicotyledonous weeds can enhance survival of the pathogen in fallow soils. Thus, infested soil is a main source of primary inoculum for the development of fusarium wilt epidemics in chickpea.

Abundant chlamydospores form in infected tissues as severe symptoms develop and the plant senesces. Eventually, these chlamydospores are released into the soil as infested debris decomposes. Chlamydospores may undergo cycles of renewal by limited saprophytic growth of the fungus supported by organic debris and root exudates (Haware *et al*. 1982). Temperature and pH ranges for mycelial growth of the fungus are 7.5 to 35 ^{0}C and 4 to 9.4, respectively; the optimal conditions being 25 to 27.5 ^{0}C and 5.1 to 5.9, depending upon the strain. Optimum pH for sporulation is 7.1-7.9. For a given temperature, isolates of the yellowing pathotype grow at a higher rate compared with that of wilting isolates (DuroAlmazan, 2000).

4. EPIDEMIOLOGY

Haware (1982) found that the fungus may be seed borne and may survive in plant debris in soil. Nene and Haware (1980) showed the fungus to be in the hilum of cotyledons and axis of the seed in the form of chlamydospore like structures. The primary infection is through chlamydospores or mycelia. The conidia of the fungus are short lived; however, the chlamydospores can remain viable up to next crop season. The pathogen survives well in roots and stem, even in apparently healthy looking plants growing among diseased ones harboring enough fungus (Haware and Nene, 1982a).

4.1. Disease symptoms

Symptoms of the disease can develop at any stage of plant growth and affected plants grouped in patches or appear spread across a field (Trapero-Casas and Jimenez-Díaz, 1985; Nene and Reddy, 1987). Highly susceptible cultivars can show symptoms within 25 days after sowing (designated 'early wilt'), including flaccidity of individual leaves followed by a dull-green discoloration, desiccation and collapse of the entire plant.

Late wilted plants exhibit drooping of the petioles, rachis and leaflets, followed by yellowing and necrosis of foliage. Initially, drooping is observed in the upper part of the plant but within few days it occurs on the entire plant. Symptoms may affect only a few branches of a plant resulting in partial wilt (Haware, 1990).

Roots of affected seedlings and plants show no external root discoloration if they are uprooted before being severely affected or dried. However, the roots and stem of a plant develop a dark-brown discoloration of xylem tissues that can be seen when they are split vertically or cross-sectioned (Jimenez-Díaz *et al*., 1989a).

4.2. Host ranges of pathogen

This fungus is pathogenic only on *Cicer* spp. (Kaiser *et al*., 1994) of which chickpea is the only cultivated species. However, *F. oxysporum* f. sp. *ciceris* can also invade root tissues of other grain legumes such as bean, faba bean (*Vicia faba*), lentil (*Lens culinaris*), field pea (*Pisum sativum*), and pigeon pea (*Cajanus cajans*) without causing external symptoms, thus serving as symptomless carriers of the pathogen. Other crops and dicotyledonous weeds can also serve as symptomless carriers (Trapero-Casas and Jimenez-Díaz, 1985).

4.3. Disease infection process

F. oxysporum f. sp. *ciceris* gains ingress in germinating seeds and growing seedlings directly without need of wounds soon after sowing in infested soil. Invasion takes place mainly through the cotyledons and zones of the epicotyl and hypocotyl at the junction of or close to cotyledons, and to a lesser extent in the zone of root elongation and maturation (Jimenez-Díaz *et al*. 1989a; Stevenson *et al*. 1997).

Later studies in infested hydroponic cultures showed that races 0 and 5 of the pathogen colonize the surface of the tap and lateral roots in both susceptible and resistant cultivars, and preferentially penetrate the meristematic cells of the root apex (Jimenez-Fernandez *et al*. 2013). Then, the fungus grows in the intercellular spaces of the root cortex to reach the central root cylinder and enter into the xylem vessels. Further colonization by the pathogen takes place by means of hyphal growth and microconidia carried in the vessels by transpiration stream, as well as by lateral mycelia spread to adjacent vessels.

4.4. Disease cycle

Entry is either direct, through wounds, or opportunistic at the point of formation of lateral roots (Gupta, 1991). The mycelium takes an intercellular path through the cortex, and enters xylem vessels through the pits. The pathogen is primarily confined to the xylem vessels in which the mycelium branches and produces microconidia (Haware and Nene, 1982a). The microconidia detach and are carried upward in the vascular system until movement is stopped, at which point they germinate and the mycelium penetrates the wall of the adjacent vessel (Backman and Turner, 1989). Lateral movement between vessels is through the pits.

The water economy of infected plants is eventually severely compromised by blockage of vessels, resulting in stomatal closure, wilting and death of leaves, often followed by death of the whole plant (Gupta, 1991; Singh *et al*. 2006).

4.5. Disease spread

Spores can be splash dispersed, rain splash and moving water can carry chlamydospores and conidia short distances to surrounding plants and adjoining paddocks. The pathogen can be transported over large distances in infected and infested seed and harvesting equipment and into new areas seed infected by *F. oxysporum* f. sp. *ciceris* may not show external symptoms of infection Windblown plant debris could spread the pathogen over moderate distances following harvest into adjacent paddocks (Pande *et al*., 2007).

4.6. Pathogen Survival

The pathogen is seed and soil borne, facultative saprophyte, in the absence of susceptible host; it can survive up to six years in the soil (Haware *et al*., 1992). When the inoculum is developed in the soil, it is difficult to check the disease or eliminate the pathogen except by following crop rotation for more than six years (Haware and Nene, 1982)

Whereas, Saxena and Singh (1987) described that in alkaline soils fungus can survive for more than 5 years. The chlamydospores of the pathogen remained viable throughout the high temperature in the summer months during the non-cropping period in naturally infected roots of chickpea at soil depth of 5, 10 and 15 cm.

Gupta (1991) isolated chickpea wilt pathogen from roots of, pigeon pea, pea and lentil grown in wilt infected plot. The roots of six out of seven winter weeds tested and six out of 15 summer weeds were found infected, indicating a wide host range and harbored by a large population.

4.7 pathogen variability

Fusarium oxysporum f.sp. *ciceris* exhibits extensive pathogenic variability despite being monophyletic. Two pathotype distinguished based on distinct yellowing or wilting syndrome that induce in susceptible chickpeas (Trapero-Casas and Jimenez-Díaz, 1985).

The yellowing syndrome is characterized by slow, progressive foliar yellowing and late death of the plant, while the wilting syndrome is characterized by fast and severe chlorosis flaccidity and early plant death. The eight *F. oxysporum* f. sp. *ciceris* races also differ in their pathotype and geographic distribution. Races 0 and 1B/C belong to the yellowing pathotype whereas races 1A through 6 belong to the wilting pathotype. Races 0,1A,1B/C, 5 and 6 have been reported in the Mediterranean region and in California (Jimenez-Gasco and Jimenez Díaz, 2003). According to (Meki *et al*., 2008) pathogenic variability studies in Ethiopia four distinct groups of isolates that categorized as races 0, 2, 3 and 4 are observed.

5. DISTRIBUTION AND INCIDENCES OF DISEASE

The status of chickpea diseases varies from country to country. Chickpea wilt caused by *F. oxysporum* f.sp. *ciceris* is widespread and has been reported from almost all the chickpea-growing regions in the world (Haware, 1990).

Mengistu and Negussie (1994) reported the occurrence of chickpea fusarium wilt in Shewa and Kefa areas of the country. The incidence of this disease was found to be as high as 100% on local variety and 21% on improved variety Marye. In northwestern Ethiopia, the distribution and incidence of chickpea fusarium wilt is also currently increasing. Bahirdar Plant Health Clinic (BPHC), in the spot survey in two administrative zones of three districts, reported the incidence of this disease from 50% to 100%.

Fusarium wilt of chickpea distribution in North Gondar, South Gondar and East Gojam administrative zones of northwestern Ethiopia during the 2006–2007 and 2007–2008 main crop seasons.

Table 1. Incidence of fusarium wilt in Gondar Zuria and Dembia districts in 2006–2007 and 2007–2008 cropping seasons.

		2006-2007			2007-2008			
Districts	Locality	E.growth stage	L.growth stage	Mean	E.growth stage	L.growth stage	Mean	Grand mean
Gondar Zuria	Lemba	19.60	54.54	37.07	32.80	52.38	42.59	39.33
	Mitirha-Abawarka	17.40	46.31	31.86	30.40	47.59	39.00	35.43
	Tsion-Seguage	18.70	47.54	33.10	10.23	52.76	31.50	32.30
	Degole-Chinchaye	18.52	53.06	35.79	34.40	55.81	45.11	40.45
	Tach Tade	16.20	49.76	32.98	6.77	17.97	12.37	22.68
Mean		18.08	50.24	34.16	23.72	45.30	34.11	
Dembia	Jangua	12.21	58.63	39.42	21.89	52.32	37.11	38.27
	Tezebe M	14.84	47.55	31.20	16.24	39.11	27.68	29.44
	Salij-chilo	19.50	54.57	37.04	20.77	49.50	35.14	36.09
	Grarghie	17.70	61.53	39.62	22.63	51.21	36.92	38.27
	Guramba	24.60	59.81	42.21	24.46	55.43	39.95	41.08
Mean G.		19.37	56.42	37.90	21.19	49.51	35.36	
Mean				36.03			34.74	

Source Merkuz *et al* (2011).

Results of surveys conducted during the 1984/85 season showed up to 25% disease incidence in Ambo and Nazreth areas of Shewa Administrative regions (IAR, unpublished). The incidence of chickpea wilt ranged from 1% to 41% (Average 25%) in Gohatsion, 4-35% (average 17%) In Nazreth 3-31% (average 15%) in Wolkite, 1-18% (average 11%) in Ambo, and 7-17% (average 11%) in Debre Berhan (IAR, unpublished).

Merkuz *et al*., (2011) reported fusarium wilt disease was found to be prevalent in almost all the surveyed chickpea-growing areas. Tebkew and Chris (2015) stated that the chickpea wilt distribution from low to high incidence in East Gojjam, South West Shewa, North Shewa and West Shewa in 2013/14 and 2014/15 in survey result. Among the most fusarium wilt highly distributed as following

5.1. Gondar Zuria district

In this district, a total of five PAs and 25 farmer fields were assessed in one way. All assessed fields were positive for the occurrence of the disease, indicating that the disease was widely distributed in the district (Table 1). In Gondar Zuria district, fusarium wilt disease was highly distributed throughout the surveyed areas, and the disease incidence ranged from 31.86% to 37.07% during 2006–2007 and 12.37% to 45.11% during 2007–2008 crop seasons. Among the five PAs surveyed in this district, highest disease incidence (37.07%) was recorded at Lemba while the lowest incidence (31.86%) was recorded at Mitirha-Abawarka during 2006–2007 and highest (45.11%) at Degola-Chinchaye during 2007–2008.

5.2. Dembia district

In Gondar Zuria district, fusarium wilt disease was found to be highly distributed throughout the assessed areas, with a mean disease incidence of 37.90% and 35.36% in the two cropping seasons, respectively. The disease incidence ranged from 31.20% to 42.21% during 2006–2007 and 27.68% to 39.95% during 2007–2008 cropping seasons respectively.

6. DISEASE MANAGEMENT

Management practices directed of the disease occurrence could be exclusion and eradication of the pathogen and to reduce its inoculum. The varied nature of pathogen involved, evolving resistant varieties has so far proved to be the best bet, although other conventional chemical, cultural methods and biological control have also yielded good results. Fusarium wilt of chickpea can be managed using resistant cultivars, adjusting sowing dates, and fungicidal seed treatment (Navas-Cortes *et al*. 1998). The use of wilt-resistant chickpea varieties and adjustment of sowing dates are potentially cheap and easily adoptable methods in managing chickpea wilt. Developing and releasing wilt/root rot-resistant cultivars is the major objective of the national chickpea improvement programme and chickpea varieties having resistance to wilt/root rot have been released for cultivation in Ethiopia (Geletu *et al*., 1996).

6.1. Cultural practices

Research on cultural control as focused only on date and depth of sowing (Alemu, 1979) and manipulation of agronomic practices. Merkuz *et al*. (2011a) reported that fusarium wilt incidence was reduced with different doses of green manure and dried plant residue, and none of the treatments showed complete disease suppression.

A. Sowing date. Effects of altering dates of sowing on the incidence of chickpea wilt/root rots were assessed at DZARC (Alemu, 1978). The recovery of the pathogens causing wilt/root rots decreased with delayed sowings. However, early sowing (end of July) provided higher grain yields as compared with late sowings (Seid *et al*., 1990).

B. Planting depth. The results of experiment showed that sowing at 6cm depth significantly improved plants and grain yield than 2,11 and 15cm sowing depths. This might have been due to less exposure of seed to adverse weather conditions, and low incidence of wilt and root rots (IAR, 1977). Planting of seeds at proper depth (10-12cm) was helpful in reducing the disease incidence while, shallow sown crop seemed to attract more disease.

C. Intercropping: (Singh and Sandhu, 1973) noted effect of wheat, barley, linseed and mustard intercrops/mixed cropping with chickpea on wilt incidence. Intercropping/mixed cropping reduced wilt incidence and increased yield of chickpea. Lowest wilt incidence obtained with intercropping and mixed cropping with linseed.

D. Spacing: Plants spaced at 15-20 cm had much higher disease incidence than those spaced at 7.5cm; this was attributed to the shallower root system in widely spaced plants which were susceptible to wilt when subjected to moisture stress (IAR, 1977).

6.2. Mechanical control

Deep ploughing over summer and removal of infected trash can reduce inoculum levels of fusarium wilt of chickpea (Haware, 1982). Solarization of soil by covering the soil with transparent polythene sheeting for 6-8 weeks during the summer months has been shown to effectively control fusarium wilt of chickpea and improve plant growth and yield (Chauhan *et al.* 1988). However, this method of control is not practical for broad-acre farming systems.

6.3. Biological control

No commercial biological control agents that directly attack Fusarium pathogens are currently available. However, potential biological agents have been identified for control of these fusarium wilt diseases. Similarly, *Trichoderma harzianum* and *Trichoderma koningii* have shown antibiosis and mycoparasitism (Mukhopadhyay *et al*. 1989). Most recently El-Hassan and Gowen (2006) have investigated the use of *Bacillus subtilis*. A comparison of formulations found that use of either talc or glucose significantly decreased disease severity and enhanced plant growth promoting activity by increasing root length. Similar results have been found for the control of *F. oxysporum* f. sp. *ciceris*, with Trichoderma spp reducing plant mortality when applied to seed and sown in the field (Kumar *et al*., 2006). Numerous other micro-organisms have been reported as potential bio-control agents of *F. oxysporum* f. sp. *ciceris* including Rhizobium (Arfaoui *et al*., 2007). Trichoderma species are more effective when integrated with moderately susceptible or resistant cultivars controlled Fusarium wilt by 30–46% (Meki *et al*., 2011). However, this method has been given no or little attention in managing chickpea wilt in Ethiopia

6.4. Host resistance

Most of the resistant varieties have been found to be susceptible after some years because of breakdown in their resistance and evolution of variability in the pathogen.

In the national chickpea improvement programme and chickpea varieties having resistance to wilt/root rot have been released for cultivation in Ethiopia (Geletu *et al*., 1996). Development of plant lines resistant to fusarium wilt is the most effective approach to the management of the disease these includes variety Arerti and Chefe. Wilt/root rots resistance varieties were evaluated at DZARC for resistance to fusarium wilt of chickpea on sick plot progressively and continually (DZARC, 2006).

Development of plant lines resistant to Fusarium wilts is the most effective approach to the management or eradication of the disease. Breeding of resistant lines and identification of DNA markers for resistance to fusarium wilt has been achieved in chickpea (Sharma *et al*. 2005). It is important to note that in some cases, resistant plant varieties are only suitable for use against certain fusarium wilt races (Jiménez-Gasco *et al*., 2004a).

6.5. Chemical control

Chickpea seed treatment with thiram + pentachloronitrobenzene or thiram + carboxin reduced the incidence of the disease (Bayaa and Erskine 1998). For chickpea obtaining useful levels of fusarium wilt control with seed-applied fungicides can be considered effective. The fungicides like Thiram and Apron star offers a good protection against wilt (DZARC, 2005).

6.6. Integrated Disease Management

Promising results were observed that combination of effective microorganism, Apron Star, stubble free and resistant variety become suppressive to fusarium wilt of chickpea and integration of effective microorganism, neem seed extracts and resistant variety had significant effects on yield and yield components (DZARC, 2009). Fusarium wilt of chickpea can be managed using resistant cultivars, adjusting sowing dates, and fungicidal seed treatment (Navas-Cortes *et al*. 1998). Merkuz and Getachew (2012) reported that raised bed preparation, tolerant variety and optimum time of planting managed the wilt incidence and reduce mortality of wilt.

CONCLUSION AND FUTURE DIRECTIONS

In production and productivity among the top ten countries, Ethiopia ranks sixth and important source of human food and animal feed crops. The gap between actual yield and potential yield more due to several abiotic and biotic factors stress. Among biotic soil borne diseases is one important chickpea wilt/ root rot disease cause severe loss across in major chickpea growing areas of the world.

In Ethiopia, these diseases in North western, Central and other distributed and prevalent on the cultivate susceptible variety than improved variety and several cultural practices during cultivations. The use of wilt-resistant chickpea varieties and adjustment of sowing dates are potentially cheap and easily adoptable methods in managing chickpea wilt. However, *Fusarium wilt* of chickpea can be better managed using resistant cultivars, bio control, bio fumigants, adjusting sowing dates, and fungicidal seed treatment. There is also high pathogenic variability in the country and need further studies of other important races through molecular techniques.

Therefore, integrated management strategies are the only solution to maintain plant health, including minimum use of chemicals for checking the pathogen population, encouragement of beneficial biological agents to reduce pathogen inoculum and modification of cultural practices and use of resistant varieties. In the future, the program should have to give more attention on development of other managements practices and multiple resistant variety, amendments of bio control agents as integrated disease management components, proving of resistant line under field condition in controlled environments, race analysis for variability studies, periodically survey for its' incidence and level prevalence, strengthen the sick plot screening techniques both in main season and irrigation based and over location verification of released variety against the existing races.

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