Huanglongbing (Citrus Greening) Severity in Nepal and its Management Strategies

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Abstract

Huanglongbing or Citrus greening, caused by Candidatus Liberobactor asiaticus (CLas) vectored by Asian Citrus Psylla (ACP), is reported in early 1960's in Nepal when citrus saplings were introduced from Saharanpur, India to Pokhara valley Presently, out of 44 citrus growing districts, 28 have confirmed greening positive result causing loss of hectares of productive mandarin groves across the country due to the disease We tried to adapt three strategies to control HLB: produce and distribute healthy saplings; eradicate diseased trees; and deter the vector of HLB (Diaphorina citri) using chemical measure with epic failure due to poor legislation and implementation strategies. There are new technological advances made elsewhere such as use of tolerant scion cultivars like sugar belle and tolerant root stocks can be tested and adapted in Nepal with necessary modifications. Testing new chemicals like Zinkicides and Homobrassinolides against Huanglongbing and use of acetic acid as sex hormone to monitor ACP activities are suggested. Further cultivation of citrus under protective screens (CUPS) for sapling, mother stock and commercial fruit production with seedless varieties is other alternatives. Some of the expensive technologies need to be tested for economic feasibility. The most important approach would be quality planting material distribution from certified nurseries under strict quarantine system. Plant protection and quarantine units across the border of states need to be strengthened to look after interstate transportation of citrus planting materials.

Keywords: *bactericides, citrus psylla, decline, HLB, citrus greening, sex-hormone*

Background

Citrus shares nearly 32% of the total area among the fruit area in Nepal. This indicates that citrus is the major fruit in Nepal, having significant place in the socioeconomic well-being of the Nepalese farmers (MoALD, 2017). However, huanglongbing or citrus greening disease is number one threat to the future of citrus industry in Nepal and unless this problem is understood and managed, citrus will slowly but surely decline (Roistacher, 1996). It has now been suspected that this disease is widespread throughout major citrus growing belts in the country and has become a serious threat for mandarin production. Some of the citrus nurseries in the country are located below 1000 masl

altitude under open sapling production system. In lower altitude areas, insect vector of greening disease (Asian Citrus Psylla-ACP) are considered active because of the favourable environment.

In Nepal, citrus decline was recorded for the first time in Pokhara valley by Thrower (1968). Based on visual observation Knorr et al, (1970) suggested that the citrus decline in Pokhara valley was caused by greening disease and suspected that the disease was introduced from Sharanpur, India with the planting materials introduced to Horticulture Research Center, Pokhara for variety evaluation. Regmi (1982) in a survey found that about 55 % citrus trees in Pokhara valley and almost 100% at Horticulture Research Station, Malepatan were infected with HLB disease in early 1980s Later, more studies and surveys were carried out in other parts of the country to explore the distribution of the greening disease and its vector (Regmi and Lama, 1988; Regmi1994; Regmi et al , 1996 and Bove, 2006). These studies revealed that HLB has already distributed in many parts of the country (Dhankuta to Baitadi) but rate of citrus decline due to this disease was maximum in Pokhara valley, Tanahu, Lamjung and Gorkha districts. Out of 44 commercially mandarin producing districts (excluding other 22 homestead producing districts) 28 districts (Dhading, Dhankuta, Khavre, Kaski, Gulmi, Syanja, Gorkha, Lamjung, Salyan, Doti, Okhaldhunga, Achcham, Chitwan, Dailekh, Arghakhachhi, Palpa, Kailali, Parbat, Myagdi, Baglung, Bhojpur, Nawalparasi, Ramechhap, Sindhuli, Makawanpur, , Tanahu, Pyuthan) have confirmed cases of citrus greening caused by CLas as per PCR analysis report from NAST (Shrestha et al., 2013 and Paudel, 2015).

HLB or Greening Management Strategies

In the past our researchers and development workers tried three approaches: eradication of symptomatic trees, vector control with chemicals, and planting of healthy seedlings/ saplings. However, the effort was not fruitful without proper quarantine of planting materials and strict bud-wood certification system. Later in 2000, National Citrus Research Program, Dhankuta proposed containerized mother plant management and grafted sapling production using certified bud-wood from the nursery above 1000 m only. Due to poor regulation and commitment from implementing agencies it was not fully implemented not even by government horticultural farms. Therefore, we need to rethink about the management of HLB from new perspective under the recently changed federal system. Hence, a new strategy has been proposed in this paper. There are ten pillars of this strategies as follows:

1. Selection of New Orchard Area

When an area is chosen to establish new citrus orchard, it should be at least three kilometer far from a HLB positive orchard. The area should itself be free from greening positive and other citrus plantation so that an orchard with fresh disease free planting material could be established (1000 m-1500 m).

2. Planting with Disease Free Saplings

It is of utmost important that a new orchard should be established with known varieties of citrus completely free from greening disease. Therefore, planting materials should be brought from a registered nursery having mother plant raised under screen house and bud-wood certified in each alternate year by concern authority using PCR test. Further, growing of the grafted plants inside a containerized nursery has to be followed by such nurseries. Therefore, at least all horticulture farms producing citrus saplings should produce grafted plants inside screen house using sterilized

media in poly bags. Planting older sapling with more than 2.5 years of age is another way to escape earlier infection of trees by the disease. Further, frequent spray of young plants for the first three years after transplantation will be useful to control the vector activity. Additionally, individual protective cover (IPC) could be trialed in new orchard to save young plants (Pic 1). In addition, whole orchard could be grown as Citrus Under Protective Screen (CUPs) (Pic 2) (Qureshi et al 2019). At present the cost of such IPC and CUPS is very high. Further, only limited number of seedless varieties of sweet oranges are suitable to grow as insect pollination is difficult under such system (http://edis.ifas.ufl.edu/hs1304).

Figure 1: Citrus under individual protective cover

Figure 2: Citrus under protective screens

(Source: Qureshi et al 2017)

3. Better Nutrition Management of Orchard

An unhealthy tree is always prone to HLB. Further, a greening positive tree needs better nutrition to revive and give better production (Qreshi et al 2019). From several studies have shown that a greening infected trees have high pH and deficiency of micro-nutrients like Manganese and Zinc and therefore a better nutritional program is needed for healthy as well as greening affected trees (Ferrarezi, 2018).

4. Proper Boarder Management

Bordering citrus plants of the orchard are first infested by ACP. It has been found in Brazil that with ACP migration, 80% infestation occurs on first 100 m area of orchard. Therefore, planting few rows of citrus parallel to inner rows of plantation will act as barrier (Tozatti, 2019). Further, there are reports that planting guava tree as a boarder plants acts as deterrent to ACP due to certain chemical produced on guava leaves (Hall et al 2008). Beside these, planting other species of windbreak trees also act as barrier to ACP. Additionally, the bordering plants need frequent application of insecticide to control ACP (7 days interval) during flushing time than the inner trees (14 days interval).

5. Frequent Orchard Inspection

In Nepal, citrus fruits (except some acidic fruits) are mostly grown in hills (900m-1600m altitude) which has very favorable cooler climate for CLas. Therefore, morphological symptom of disease

development could be seen throughout the year. However, it is distinctly visible during climatically stressed (winter and rainy) period. Sometime the disease symptom on leaf is confused with zinc and fruit symptom with magnesium deficiency. Therefore, orchard need to be inspected for diseased tree at least 3-4 times a year. While doing inspection merely walking is not enough as the trees are taller than inspecting person in Nepal. Use of ladder or certain platform to reach for top of the canopy is advised as this is twice effective in identifying HLB infected plants than just walking. Further, one should be careful that disease symptom is expressed earlier in young plants and it even takes two years in older trees. There are more than 10 zone and super-zone dedicated to citrus fruit and these offices need to work on PCR test of suspected trees each year.

6. Eradication of Symptomatic Trees

The trees with HLB symptoms need to be cleared off and properly disposed so that it could not act as source of infection to other trees of orchard. In Brazil and USA when > 25% plants of an orchard are found infected the orchard is declared as 100% contaminated (Tozatti, 2019). However, in Nepal fruit growers live with greening disease and seek for compensation to remove the diseased tree and the problem of HLB further aggravates. Recent examples are Chiti and Dhamilikuwa area of Lamjung, and Kristi and Bharatpokhari area of Kaski. Program of public awareness and campaign on removal of disease tree should be implemented by all three governments under recent federal system.

7. Citrus Psylla Monitoring

Asian Citrus Psylla are so tiny that it is difficult to see them with our naked eyes. It is advisable to look for them underneath the new flushes with magnifiers. When there are no new flushes in citrus species, these insects could harbor on Kamini flower (Murrya paniculata), Curry leaf plant (Murrya koenigii) and beal plant (Aegle marmelous). Monitoring of these plants and removing off them is worth considering. Use of yellow sticky trap at 200 meter interval at upper 1/3 part and outside canopy is advised. It should be monitored at weekly interval and replaced at fortnightly interval (Tozatti, 2019). Recent research showed that acetic acid could be used as sex hormone to monitor ACP activity.

8. Citrus Psylla Management

When the citrus plants start producing flushes systemic insecticide (3-4 times) need to be sprayed at every fortnightly interval until flushing stops in ACP prone and HBL infected orchards. One spray of systemic insecticide is also advised during dormant season (winter) to ward off harboring adult ACP. The seedlings/saplings which are ready to plant also need to be sprayed with insecticide beforehand. Mass rearing and release of natural enemies (like Tamarixia radiata) of ACP are also practices in some part of the world.

9. Neighboring Area Management

If a grower leave his HLB declined orchard abandoned or untreated it becomes source for other neighbouring orchards. Therefore, care also need to be taken on monitoring and management of ACP from neighbouring orchards for effective HLB management. Therefore, citrus growing communities and Zone and Super zone office need to make plan on removal and or monitoring ACP and insecticide application to such orchards for effective HLB control.

10. National Level HLB Management System

There is urgent need of National level HLB management guidelines which need to be followed by all three level of government (Local, State and Federal). There is rampant distribution unhealthy citrus planting materials of un-identified sources by both private and government agencies. It needs to be stopped immediately. Further, various other agencies and I/NGOs are also distributing seedlings to farmers without considering health of planning materials. A quarantine office at boarder of each state to check quality certificate is of present need. A technical guideline on containerized nursery management and budwood certification system need to be immediately formulated and used by state and federal government bodies to regulate the 180 private nurseries operating within the country. Further, surveillance and forecasting of ACP and insecticide application time should be initiated both for healthy and disease prone area. NCRP, Dhankuta could set up a website where information on ACP surveillance data at local, Zone, Super zone level and Gyan Kendra level will be fed into system. Further, the PCR analysis result, meteorological data and Soil analysis data from all agriculture related offices of all three level of government will be fed into same website. The website will serve as interactive dashboard and provides necessary information to all stakeholders free of charge. Further, a registered citrus grower will get an advisory message on his/her mobile phone regarding when to apply control measure to ward off the ACP from their orchard.

Besides, there are many other technological innovation happening around the globe like use of tolerant rootstocks, varieties and chemicals (Homobrassinolides) (http://bit.ly/2Unmmfk) and bactericides (Zinkicide, Bullet HLB) (Ghosh et al 2018) which are under research phase. These need to be tested by NARC system and information be provided to the concerned stakeholders as soon as possible.

References

Batol, A., Y.Iftikhar and S.M. Mughal. 2007. Citrus Greening Disease- A Major Cause of Citrus Decline in the World. Horticultural Science 34(4); 159-166.

Bove, JM. 2006. Huanglongbing: A Destructive, Newly Emerging, Century-old Disease of Citrus. Journal of Plant Pathology 88(1): 7-37

F.A.Alifares. 2009 Best Management Practices in Citrus Production. Tree and Forestry Science and Biotechnology 3(1): 1-11.

FAO. 2016. FAO statistics. (http://www.fao.org/faostat/en/)

FAO.2011. Improved Production Technologies with Particular Focus on Combating Citrus Decline. In: Training manual for combating citrus decline. Food and Agriculture Organization of United Nations, TCP/NEP/3302 ;(D) - July, 2011.

Ferrarezi, R. S., Wright, A.L., Morgan, K.T., Stansly, P.A., Ozores-Hampton, M., and Ebel, R. 2018. Foliar Nutritional Research Update. Citrus Industry Magazine 6th March 2018 (http://bit.ly/2ThpjOr)

Ghosh, DK., Kokane, S. , Kumar, P, Ozcan, A., Warghane, A., Motghare, M., Santra, S. , Sharma, A.K. 2018. Antimicrobial nano-zink-oxide- 2s albumin protein formulation significantly inhibits growth of “Candidatus Liberibacter asiaticus” in planta. PLoS ONE 13(10): e0204702. https://doi.org/10.1371/journal.pone.0204702

Hall,D.G.,F.R. Gottwalld, C.M. Nguyen,K. Ichinose, L.Q. Dien and G.A.C.Beattie.2008.Green House Investigation on the effect of Guava on Infestation of Asian Citrus Psyllid in Grapefruit. Pro. Flo.State Hort.So.121:104-109.

Knorr; LC, S. M. Shah and O P Gupta. 1970. Greening Disease of Citrus in Nepal Reporter 54: 1092-1095

MoALD. 2017, Statistical Information on Nepalese Agriculture (2073/74). Ministry of Agriculture and Livestock Development, Singhdurbar, Nepal

Paudel, K.P. 2015. Technological Advances in Huanglongbing or Citrus Greening Disease Management. J. Nepal Agricultural Research Council. 1:14-51

Qureshi, J., L. Stelinski and F. Alferez. 2019. HLB reduction Strategies. Published in Citrus Industry magazine (http://bit.ly/2HnodiG)

Regmi C and TK Lama. 1988. Greening incidence and greening vector population dynamics in Pokhara. Proc. 10th Conference of International Organization of Citrus Virologist (IOCV), (LW Timmer, SM Garnsey and L Navarro eds.), 12-21 Nov. 1986, Valencia Spain. Pp.238-242.

Regmi, C. 1982. Mycoplasma-like diseases of citrus in Nepal and USSR (spread, effect, etiology, varietal resistance. possible vectors). Ph.D. dissertation. Moscow Agricultural Academy, Moscow. pp. 144

Regmi, C. 1994. Detection of citrus greening disease by using DNA probes. In: Proc. 2 National Conf on Sci. and Tech. Royal Nepal Academy of Science and Technology, Kathmandu, Nepal. pp. 394-398.

Regmi, C., M. Gamier and J.M. Bove. 1996. Detection of the Asian Huanglongbing (Greening) Liberobacter in Nepal by DNA-DNAhybridization, In: Proc. 13th Conf IOCV. IOCV (Eds. J. V. da Graca, P Moreno, and R. K. Yokomi). Reverside, California. pp. 267-270.

Roistacher.C. N. 1996.Assessment of the greening problem, the severity and prevalence of virus and virus-like diseases and development of appropriate set of procedures for a citrus certification program for Nepal. ATSP Nepal, Kathmandu.

Rouse, B., M.Kesinger and N.Jameson.2007. Citrus Nursery Issues; Protective Structures Budwood and Tree Avaibility. UF/IFAS South west Florida Research of Education Center Immokalee. (http://bit.ly/2ThpjOr)