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MANAGING INSECT PESTS & DISEASES OF CITRUS: ON FARM ANALYSIS FROM PAKISTAN

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A B S T R A C T

Population pressure is increasing demanding more food for sustainable future but competition for key resources is high due to prevalence of insect pests and diseases. Numerous losses have been recorded due to diseases infestation in Pakistan particularly in case of citrus. On farm technicalities are increasing while farmers' technical knowledge is stagnant making insect pests and diseases pathogens resistant. Citrus is leading fruit and its better productivity is vital for the farmers and national economy but per acre production is lower that potential. Insect pests and diseases role is counted as significant in lowering the production. Therefore presents study was undertaken to explore growers concerns. 120 respondents were selected using probability sampling technique under survey based research design. Findings indicated that growers were more familiar to insects/pests attack than diseases infestation. The adoption of cultural and mechanical control was found more prominent method to manage diseases impacts. Lack of technical knowledge, Finance shortage, and high cost of inputs were the major adoption militating factors among growers. Micro credit schemes should be started by the public sector to alleviate the finance problem and trainings should be imparted by the pathology and entomology experts along with extension agents to adopt alternate way to manage the viral diseases.

Keywords: Communication gap, citrus, plant protection, agriculture extension.

INTRODUCTION:

The present day citrus is delectable, juicy, and seedless and is of great nutritional significance as well. Additionally, it possesses enormous therapeutic qualities (Chaudhry *et al*., 1992). The prevailing climatic conditions in Pakistan are suitable for the successful cultivation of citrus (Syed, 2007). Punjab is the centre of production and supply citrus fruits of high quality and grade worldwide. The major citrus growing areas in the Punjab are Sargodha, Sahiwal, Jhang, Mianwali, Multan, Rahim Yar Khan and Toba Tek Singh, respectively (Govt. of Pakistan, 2009) but Sargodha is the dominant in citrus production holding enormous export potential as well. Being the major fruit crop of Pakistan citrus holds a key importance regarding export and as far as quantity is concerned Pakistan exports about 533 thousand tons of citrus (Govt. of Pakistan, 2011). Pakistan is considered as one of the largest producers of Kinnow. During 2010-11 the total area under citrus cultivation was 198.4 thousand hectares (ha) with total production of 2150.0 thousand tonnes (Govt. of Pakistan, 2011). At present, in Pakistan average production of citrus is 9.5 tons ha-1 (FAO, 2009) while the potential yield of citrus is 18-20 tons ha-1 which is almost half (50%) of the potential. So, there exists significant production gap between attained and potential yields.

Mentioned production gap is associated with several factors like most dominant factor insect pests and diseases. Batool *et al*. (2007) documented that citrus diseases has emerged as potential threat to citrus productivity globally. Likewise in Pakistan greening diseases is the major cause of citrus decline. Researchers further depicted diseases as graft transmissible, in nature, it is transmitted by psyllid vectors identified as *Trioza erytreae* (Del Guerico) in Africa and *Diaphorina citri* (Ku -wayama) in Asian countries.

Iqbal *et al*. (2009) identified that reduced technical

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efficiency of farmers leads them to no information about viral, pest related, air borne and soil borne diseases causing severe loss of orchards. Akhtar and Ahmed (1999) noted severe loss of citrus due to these diseases like 22% in Kinnow, 25–40% in sweet orange, 15% in grapefruit, 10% in sweet lime, and 2% lemon. Arif *et al*. (1962) highlighted the average incidence of citrus Tristeza Closterovirus (CTV) 27%, citrus variegation ilarvirus (CVV) 31%, citrus exocortis viroid (CEVd) 16%, citrus cachexia viroid (CCVd) 4%, citrus greening (*Liberobacter* sp.) 4% and stubborn (*Spiroplasma citri*) 2%, respectively. High incidence of these devastating pathogens has caused the severe citrus decline syndrome and drastic yield and quality losses in citrus fruits in the region.

Diseases are not only identified in the Punjab but also in KP as well and citrus tristeza has been considered as major cause of decline (Bove, 1995). Preliminary survey conducted by a group of Italian and Pakistani experts in 1988 with the co-operation of Ministry of Foreign Affairs and Pakistan Agricultural Research Council (PARC), citrus was reported to be infected by a number of virus and virus-like diseases in NWFP and Punjab, Pakistan (Catara *et al*., 1988). Still at present situation is more adverse and most of the citrus orchards are about to collapse in Punjab as about cent percent of citrus trees are infected with one or more virus and virus like diseases costing hue economic loss. The major virus and virus-like diseases of citrus trees reported in Pakistan are tristeza, infectious variegation, exocortis, cachexia-xyloporosis, greening and stubborn (Catara, 1987; Catara *et al*., 1988). Due to these inevitable circumstance farmers remain unable to manage the strike of diseases resultantly they obtain reduced production on farmers level and o country level production wise Pakistan is far behind as compared to other citrus growing countries of the world. By increase in cultivation area, better disease management, appropriate supply of nutrients, control on fruit disorders and several pre and postharvest techniques worlds other countries are getting per hectare yield almost double than Pakistan (UNCTAD, 2004) such as USA 22.41 tones ha-1, Brazil 22.38 tones ha-1 and Turkey 16.11 tones ha-1 (FAO, 2009). Although citrus crop is kept in large value, yet its present status is threatened by a number of problems, including low production caused by diseases. Citrus growers in Pakistan rely on chemicals for the control of citrus pests which poses negative effects on the beneficial insects (Giovanni, 1996). Due to WTO constraints, farmers have to rely on non-chemical methods. Citrus plant is attacked by number of diseases like citrus canker, gummosis, citrus decline, CTV, and greening etc. The low per hectare yield may be attributed to lack of effective control of insect/pests like citrus leaf minor, mealy bug, red scales, mites, termites, aphids and jassids, fruit fly and diseases like root rot, sudden death (quick decline of citrus), wither tip and citrus canker. These insects/pests and diseases not only affect the yield of citrus but also deteriorate the fruit quality. Lack of information about control of diseases and plant protection measures on the part of citrus growers are other factors that affect the production and quality of citrus fruit (Tariq *et al*., 2007). All these factors relate to adoption gap which is directly associated with the guidance provided by various extension agencies and other sources. A number of public and private agencies are involved in extension work (Ngomane *et al*., 2002). These are mainly responsible for dissemination of improved citrus protection measures among the citrus growers through varied approaches.

METHODOLOGY

Citrus is produced in four provinces of Pakistan but the Punjab holds 95% of the total production (Sharif *et al*., 2005; PBIT, 2012). Sargodha mainly comprises flat, fertile plains, which are the ideal conditions for cultivation of the land. Climate varies from extreme heat and cold with maximum temperature 50˚C (122˚F) in the summer whiles the minimum temperature as low as freezing point in the winter. Therefore, it is the Pakistan's best and leading citrus producing area (Sarwar *et al*., 2012). Therefore, study was carried out in tehsil Kot Momin of district Sargodha where major occupation of people is also citrus farming.

Sampling Procedure and Sample Size: A multistage sampling technique was used in selecting the respondents for the study. Study area consists of total 24 union councils. Out of total 24 union councils, 22 were rural and the remaining 2 are urban. Out of 22 rural union councils, five were selected randomly. From each selected union council, two villages were selected at random. From each of the selected village, twelve citrus growers were selected by simple random sampling technique, thereby making a sample size of 120 respondents.

Data Analysis: Collected data were analyzed using Statistical Package for Social Sciences (SPSS). Descriptive statistics were used including frequencies, percentages, and mean values.

Distribution of respondents according their awareness regarding insects/pests and diseases

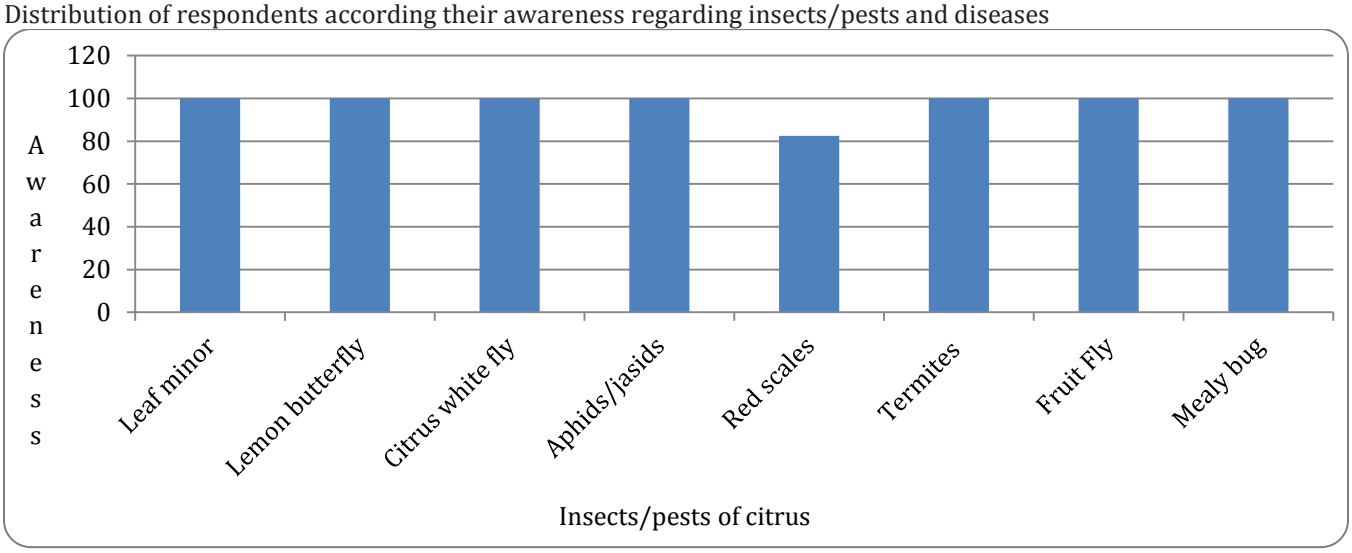

Figure 1. Insects/pests awareness.

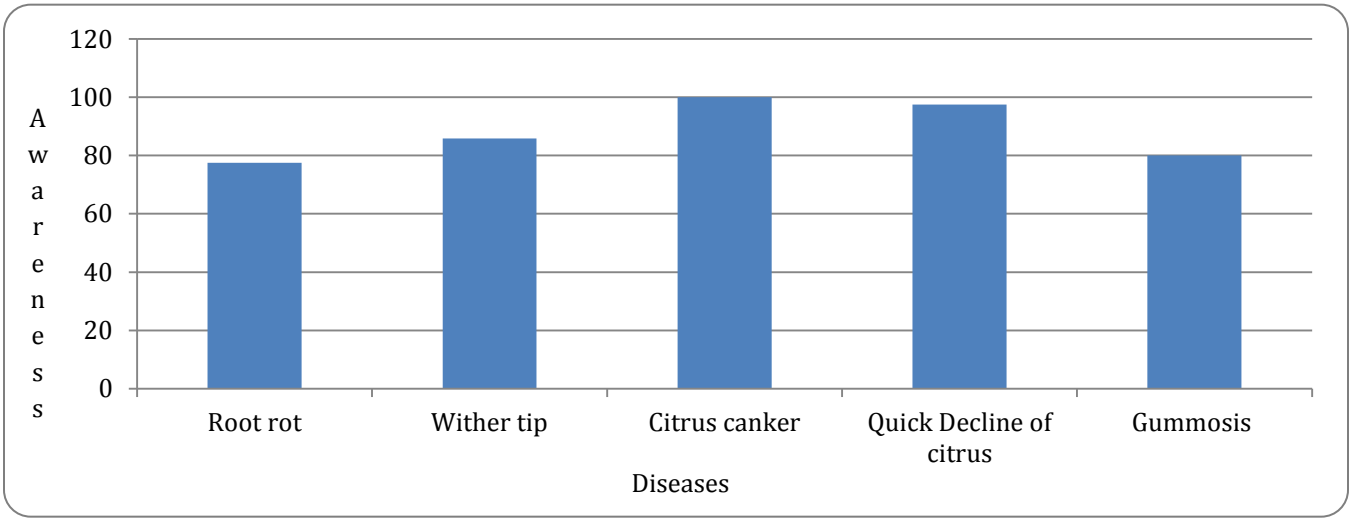

Figure 2. Diseases awareness.

Awareness level of the farmers regarding insects pests and diseases: Insects/ pests and diseases hinder the expected production of citrus (Arndt *et al*., 2008). Therefore, it is said that along with recommended production technology adoption of recommended protection technology is also essential for good quality production. Figure 1 revealed that most of the insects/pests were familiar to majority of the respondents in study area except the red scales locally known as 'kara" and "jaala" familiar among overwhelming majority (82.5%) of respondents. Growers were cent percent aware of citrus canker disease because of its devastated impacts from couple of years. Epidemic impacts of citrus canker are endorsed by Arif *et al*. (1962) declaring widely distributed disease of Indo-Pak sub-continent.

Citrus canker occurs predominantly in citrus growing regions of the Punjab affecting leaves, twigs and fruits. Moreover, leaf spotting and rind blemishing disease are also the symptoms (Gottwald *et al*., 2002). Almost entire study sample (97.5%) was familiar of quick decline of citrus because of its devastating impact and cultivation problem on citrus plants while citrus wither tip and citrus root rot were known to 85.5% and 77.5% respondents respectively. The reason of this high awareness was the immense interest and experience of the citrus growers and strong link of Extension field staff with the growers. Few of the farmers also highlighted the activities and campaigns of privet firms like pesticide agencies. Growers were further inquired about their activities to manage the severity of insect pests and diseases.

Table 1. Distribution of respondents' regarding control of the insects /pest and diseases.

Cultural control	Awareness Frequency	Adoption Frequency
Using recommended method and time for transplanting of citrus nursery plants	120 (100)	103 (85.33)
Using disease free nursery plants	120(100)	109 (90.33)
Ploughing under shadow of trees	111(92.50)	101(84.16)
Hoeing and weeding	120(100)	87 (72.5)
Removal of crop residues	118(118)	99 (82.5)
Mechanical Control		
Destruction of diseased plants/parts	120(100)	81(67.5)
Pruning and removing of disease shoots	120(100)	114 (95)
Drum beating	101(80.83)	21(17.5)
Chemical control for sucking insects/ pests		
Confidor @2-2.5ml/L, Matasyston 50% @ 500g 450 L Water	104(86.66)	71(59.16)
Malathione , Matasyston	94(78.33)	43(35.83)
Malathione 57% 500g 450 L Water	91(75.83)	24(20)
Dizenon 40%, Eldrine 20%. 1 kg in 450 L water	87(72.5)	24(20)
Parathion , Malathione @ 752g in 450 L water /acre	98(81.6)	37(30.83)
Fungicides/practices for diseases control		
Remove the soil from around the affected trees without damaging the roots and use Redo mill and Elite	97(80.83)	81(67.5)
Use of Bordeaux paste after cutting affected branches from the trees.	89(74.16)	69(57.5)
Cut & remove the affected trees & spray Formaldehyde at the spots from where diseased shoots have been removed and use Bordeaux Mixture	101(84.16)	77(64.16)
Removal of fruit present in extra amount on tree and control termite attack around the stem and root	109(90.8)	39(32.50)
Biological Control		
Pheromone traps 4-6 per plant for fruit fly	120 (100)	26(21.66)

Source: Field Survey 2012 Note: Values in Parenthesis are percentages

Data regarding cultural control mentioned in Table 2 depicted that cent percent respondents were aware of using recommended cultural practices such as time of transplantation, disease free nursery usage and hoeing and weeding. Overwhelming majority (98.33%) and (92.5%) of the respondents were also aware of cultural control such as removal of crop residues and ploughing under shadow of trees. However, the adoption level of these practices was found different from awareness as adoption varied to 72.5%-90.33% range. During informal discussion with growers, reasons behind the low adoption were high fuel prices and non-availability of machinery on time perform these activities mechanically promote the productivity. In case of mechanical control techniques, destruction of diseased parts/plants and orchard maintenance issues just like pruning and removing of diseased shoots were known to all respondents but regarding adoption pruning and removing of disease shoots appeared prominent. Pruning is a common task necessary for best production of citrus fruit (Wright and Kelly, 2008) and dominance was seen on farmers' level. Pruning methods and timings were observed different during informal discussion as some growers were performing pruning season to season while few were addicted of monthly with the help of labour. Adoption of drum beating technique to control fruit fly was found among less than half (45%) of the respondents. Scientific pruning of citrus was also being practiced by the growers in orchards for vigorous health of plant and better quality fruit. Adopters quoted *"They perform pruning on the branches by leaving distance of 1ft from trunk or stem horizontally and as well as vertically (top to bottom line)".*

According to adopters scientific pruning saves the plant from natural calamities i.e. storm or fast winds etc. as fruit will bear inside the leaves and twigs and will remain safer from climatic effects. Resultantly fruit will be vigorous with intense and gleaming colour. Chemicals

always have important role in controlling the insects/pest or diseases attack so the data mentioned in Table 2 revealed that overall the awareness of different chemical was above average but adoption was found below average. The recommendation of (Confidor @2-2.5ml/L, Matasyston 50% @ 500g 450 L Water) was found most prominent against sucking insects/pests and the adoption of rest of the chemicals was much lower. Different chemicals of various national or multinational pesticide agencies were also being used by the growers. Most popular product was Resham (2ml+1L water/plant) to control aphids and white fly on citrus. Aphids can play role in enhancing leaf infestation up to 25% (Sonya, 2007). Moreover, Polyetrenc (2ml+1L water/plant) chemical also was being used in study area to control red scales, mealy bug and fruit fly. To control the attack of termites a chemical chlorophenofas was taking height. Other insecticides such as Diptrix, Border (Perphenofas + chlorpyrifos) and Amidacloprid in powder form were being used by the growers. A range (74.16%-90.8%) of growers was also having sound knowledge of fungicides against diseases but almost half of the range was adopter of these fungicides.

Bordeaux mixture (1kg: Copper Sulphate: 1kg: Calcium Oxide, 100 L water) as a spray was being used on citrus plants to eradicate the yellowing of leaves, wither tip disease and termites. Root rot was being controlled by the growers through using the (Copper Sulphate + Calcium Oxide) in the roots of the plants. Root rot is the only disease that also can spread from nematode as reported by Calabretta (1995) and Elekcioglue (1995) that the presence of citrus nematodes caused the great damage to citrus roots in Italy while the citrus nematodes infestation level increased with the age of the citrus plants. The use of chemicals to manage citrus canker has been reported by several research workers as citrus canker caused by the bacterium *Xanthomonas campestris* pv. *citri* (Hasse) Dows, is probably the worst enemy to the citrus plantations (Awan *et al*., 1992). Although antibiotics like Agrimycine-100 and Streptomycin sulphate are the best chemotherapeutant to manage the disease (Leite *et al.,* 1987; Moses & Chandramohan 1993; Masroor, 1995). Application of Streptomycin sulphate and Agrimycin-100 helps to alleviate the citrus canker disease (Khan *et al*., 1992) but the adoption of these recommendations was not found in the study area. Reasons explored could be the expensiveness of antibiotics and scarcity in market. In this regard growers were found with the usage of fungicide Topsin M and Thyophanate. Bordeaux paste was also in trend against quick decline of citrus. Meanwhile the adopters from the small farmer category were low in numbers because mostly adopter was financially sound growers holding large landholdings. Small farmers cannot afford these chemical because of finance shortage (Ngoc Chi, 2005). This shortage leads them to be called as non-adopter and compelled to get much lower return than the expectations. These findings are also supported by Dhat (2004). Adoption of biological control (21.6%) was found extremely lower than the awareness level. Growers were further inquired to explore the constraints being faced by them.

Table 2. Factors hindering the adoption level of growers.

Constraints	Mean	S.D	Rank Order
Technical knowledge	4.37*	0.87	1
Finance shortage	4.21*	1.00	2
Marketing conditions	4.21*	1.11	3
Costs of inputs	3.91*	1.25	4
Adulteration in chemicals	3.99*	1.34	5
Interest of citrus farming	3.01*	1.70	6
Lack of education	2.70	0.60	7
Technical labour	2.11	0.51	8
Carelessness	1.82	1.08	9
Availability of spraying machinery	2.03	0.88	10
Cooperation of EFS	1.33	0.66	11
Natural calamities	1.12	0.36	12

*Significant constraints

The data given in table 2 depicted that lack of technical knowledge appeared major and most significant constraint to adoption of plant protection measures. Farmers argued that being familiar to diseases is not enough we need updated knowledge to encounter the future challenges like insects pests diseases infestation

and climate change. Finance shortage and inadequate marketing obtained 2nd and 3rd highest mean value respectively enlightening the key importance of low prices and feasible rates in adoption on technology. Growers are already finance deficit and they get reduced outcome due to improper market; then they are compelled to purchase expensive inputs like insecticides and fungicides which are mostly adulterated. Its common perception, insecticides applied is adulterated and growers remain unable to control insects' pests and diseases. Moreover, farmers applied excessive application of chemical increasing the resistant level in insect pests and diseases pathogens. Therefore, virus never has been controlled. Carelessness, spraying machinery problem, cooperation of extension field staff and natural calamities got the lowest mean value among adoption hindering problems.

CONCLUSION AND RECOMMENDATIONS

On the basis of findings it is concluded that awareness level of farmers is at average level but adoption is below the average. Farmers know the affecting pathogen but unaware about the management trick. Instead of awareness acquisition growers needs training to boost the technical knowledge, finance for investment and pure chemicals for better protection. Poor farmers friendly micro credit schemes should be launched in the study area to promote the technology adoption for the country's' leading fruit. Growers were found more addicted to expensive chemicals they should be make aware of bio-control and in order to promote bio-control instead of chemicals, there is a need to monitor pest population regularly especially the peak time of insects/pests emergence. In this perspective the role of Extension worker will be a key along with the experts from Plant Pathology and Entomology. Pathological lab research may can be started to identify the most viable solutions to control the infestation on micro level.

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