FARMER'S KNOWLEDGE, PERCEPTION AND MANAGEMENT PRACTICES OF TOMATO YELLOW LEAF CURL VIRUS DISEASE IN DUMURIA UPAZILA

A Thesis

By

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A thesis submitted to the Agrotechnology Discipline of Khulna University in partial fulfillment of the requirements for the degree of Master of Science in Plant Pathology

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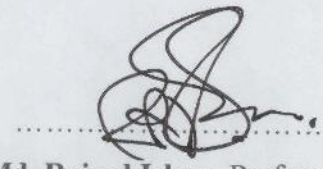

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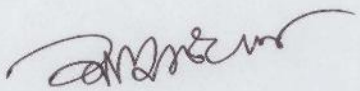

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ABSTRACT

Tomato (Solanum lycopersicum L.) is a popular vegetable crop in Bangladesh as well as many countries in the world. Tomato yellow leaf curl virus (TYLCV) is infamous for tomato-infecting viruses and causes a huge loss of the yield irrespective of the knowledge, perception and management practices of farmers. So, in order to find out the relationship between farmers knowledge, perception and management practices on TYLCV disease of tomato and their socioeconomic characteristics, a study was carried out. The study was conducted at three villages under Dumuria upazila of Khulna district. The sample population was 87 randomly selected from 3 villages. Among the 10 selected characteristics of the respondents' farm size, annual family income, organizational participation, extension media contact and training exposure of the respondents showed a significant positive relationship with their knowledge on TYLCV disease. Extension media contact showed a significant positive relationship with the perception of the respondents on the disease. 42.5% of the respondents were middle aged, 43.7% of the tomato cultivators had primary level of education, 47.1% of them had medium sized family, 86.7% of the farmers had small sized farm, 39.1% of them were short experienced, 50.6% of them had low experience in tomato cultivation, 50.6% of the farmers had medium income, 73.6% had low level of organizational participation, 54% had medium scale extension media contact, 39.1% of the farmers belongs to low training exposure category. Most of the farmers (55.2%) had medium knowledge, 57.5% of the farmers had moderately clear perception and majority (84.8%) of the farmers followed medium management practices on TYLCV disease. Perception on chemical control to control insect vector ranked 1st, among all the management practices maintaining proper sanitization during intercultural operation ranked 1st. The result of the study reveals that most of the farmers solely dependent on chemical control rather than following any biological or indigenous (Spreading ashes/Spray of neem water,etc.) methods; due to their lack of knowledge and unclear perception of TYLCV disease.

Key words: Tomato yellow leaf curl virus (TYLCV) disease, Farmers' knowledge, perception, management practice.

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CHAPTER I
INTRODUCTION

1.1 Background of the study

Tomato is one of the most important vegetables in the world. It is an important cash and industrial crop in many parts of the world (Babalola *et al.*, 2010). According to FAO (2020), in world vegetable production, it ranks 2nd in the world's vegetable production next to potato. Wilcox *et al.* (2003), studied the significant role of tomato in human nutrition, because of its rich source of lycopene, minerals and vitamins such as ascorbic acid (Vitamin-C) and β-carotene (Vitamin-A) which are antioxidants and promote good health. About 187 million tons of tomatoes were produced in the world in 2020, as reported by FAO.

The cultivated area under tomato was 18.8 thousand hectares with a total production in Bangladesh of 251 thousand metric tons (BBS, 2020). Tomato is grown in the summer and winter seasons in Bangladesh; however, production varies in various regions due to varieties, seasons, climatic conditions, planting times, management practices and soil properties (Rahman et al,. 2003). However, due to its continuous large-scale production throughout the year, it has become susceptible to a number of pathogens, limiting its production. Apart from a number of bacterial and fungal pathogens which cause severe infections on tomato, it is infected by a number of viruses (Shahida *et. al.*, 2022).

The impact of TYLCV on tomato production has been reported to be severe. If plants are infected at an early stage, they do not bear fruit and their growth seems to be severely stunted. Other symptoms that are typical for the disease are yellow (chlorotic) leaf edges, upward leaf cupping, leaf mottling, reduced leaf size and flower drop. The typical symptoms produced by TYLCV can be used for virus identification although it needs skillful observation. TYLCV was first reported by Akanda (1991) in Bangladesh Since then efforts have been made to characterize the virus systematically, manage the disease through cultural practices like manipulation of sowing dates, growing seedlings in net-house and also by the application of

1.3 Justification of the study

The trend of area increase under cultivation and production of tomato indicates its importance as a crop. The average yield of tomato in Bangladesh is very low as compared to world average. Average yield of tomato in the world is 27 t/ha in contrast to around 7 t/ha in Bangladesh. Among the yield limiting factors of tomato, virus diseases play an important role all over the world. In all 36 different viruses have so far been recorded in tomato (Jones et al,. 1991). Among the diseases of tomato virus diseases are considered to be most important ones. Of the viruses infecting tomato TYLCV is considered to be the major one. Tomato yellow leaf curl virus (TYLCV) is transmitted by whitefly (*Bemisia tabaci* Biotype B =*Bemisia argentifollii*) in a semi persistent manner in the field. TYLCV can cause up to 100 % yield loss depending upon severity and stage of infection (Shahida *et. al,*. 2022). Considering the above fact the researcher became athirst to undertake a study on "farmer's knowledge, perceptions and management practices of tomato yellow leaf curl virus disease in Dumuria upazila"

1.4 Significance of the study

Tomato yellow leaf curl virus (TYLCV) is one of the most studied plant viral pathogens because it is the most damaging virus for global tomato production. In order to combat this global threat, it is important that we understand the biology of TYLCV and train our farmers by finding out their actual knowledge, perception and management practices of tomato yellow leaf curl virus disease.

1.5 Limitation of the study

The following limitations were observed in conducting the present survey:

i. the study was detained only to Dumuria upazila of Khulna district
ii. the sample size was limited
iii. the surveyor was dependent on the furnished data of the selected respondents
iv. Major information, facts, and figures supplied by the respondents were applicable to the ambience in the locality during the last winter season.

1.6 Definitions of some terms related to this study

Various terms were used throughout the study are defined below for clear understanding.

Respondent

Farmers who answer questions those were asked by the interviewer for a social survey are called respondents. They are the people from whom a social research worker usually gets most of data required for his research. In this study, the farmers who responded to the questions during interview conducted by researcher himself were considered as respondents.

Knowledge on TYLCV disease

Knowledge on Tomato yellow leaf curl virus disease refers to the extent of basic understanding of the farmers in different aspects of tomato yellow leaf curl virus (TYLCV) disease.

Perception on TYLCV disease

It treats the willingness/ unwillingness of a farmer to take part in Tomato farming.

Management Practice on TYLCV disease

It refers to the cultivation processes, types and works that are done by the farmers regarding to manage tomato yellow leaf curl virus disease.

Age

Age of the farmers refers to the period of time in years from his birth to the time of interview.

Educational qualification

Educational qualification refers to the ability of an individual to read and write or having formal education received up to certain standard of full schooling years.

Family size

Family size refers to the number of members in his family including himself, his wife, children and other dependent members.

Farm size

Farm size refers to the farmer's area of ownership and area under tomato cultivation in hectare.

Experience

It refers to the experience of respondents in farming and tomato farming.

Organizational participation

It refers to the involvement of the farmers in different organizations.

Annual family income

It refers to total earning of the respondents from agricultural and non-agricultural sources. It was expressed in thousand Taka.

Extension media contacts

It refers to the facilities available to use different mass media such as TV, radio, contact with peer group, DAE officers and other agricultural agents.

1.7 Acronym and abbreviation

TYLCV: tomato yellow leaf curl virus

KPM: Knowledge, perception, management

CHAPTER II
REVIEW OF LITERATURE

The chapter deals with the review of relevant literature of the present study. Adequate numbers of directly related literatures were not readily available for this study. However, the literatures of available studies have been briefly discussed in this chapter,

2.1 Reviews Related to Knowledge, Perception and Management practices

A. Muqit and A. M. Akanda in 2006 conducted an experiment on TYLCV. In their study, Tomato seedlings were raised in the netted seedbeds before transplanting in order to study the effect of netting on the incidence of Tomato yellow leaf curl virus in the field. Two types of nets, namely, fine (40 mesh) and coarse (10 mesh) and insecticidal spray with imidacloprid @ 0.1% were used in the experiment. Disease incidence and severity, yield and yield contributing characters were recorded. Results show that the disease incidence was reduced by 12 to 37% and yield was increased by 5 to 21% due to netting and pesticidal spray. Of the two types of nets, fine net (40 mesh) was more effective than coarse net (10 mesh).

The findings of N. Nagaraju, H. M. Venkatesh, H. Warburton, V. Muniyappa, T. C. B. Chancellor and J. Colvin in 2002, showed that farmers were familiar with ToLCVD (Tomato leaf curl virus disease) and regarded it as a serious constraint upon production, particularly in the hot season. However, only 2% of farmers were aware that tomato leaf curl virus (ToLCV) was transmitted by a whitefly vector, Bemisia tabaci. A similarly small number of farmers knew that ToLCVD was caused by a virus, whilst 86% of farmers believed that it was caused by high temperatures. Approximately 90% of farmers relied primarily on pesticides for control of ToLCVD.

N. Monalesa1, M.S. Ali and M.R. Islam had conducted a study in 2016 to determine farmers' knowledge and attitude towards summer tomato cultivation and also to explore the relationships between each of eight selected characteristics of the farmers and their knowledge and attitude towards summer tomato cultivation. It was found that the majority (52.4 percent)

of the farmers' possessed high knowledge, while 42.6 percent of the farmers possessed medium knowledge and only 5 percent of the farmers had low knowledge on summer tomato cultivation. It was also found that about 49.5 percent of the farmers had favorable attitude, while 37.6 percent farmers had unfavorable attitude and 12.9 percent farmers showed neutral attitude towards summer tomato cultivation.

The most effective way of managing Tomato yellow leaf curl virus is by use of an integrated management package, which combines cultural practices, insecticide application, UV-absorbing plastic films, insect vector proof nets, and variation of weather conditions like light intensity, photoperiod and temperature (Mazyad *et al.,* 1986; Cohen and Antignus, 1994; Perring *et al.,* 1999; Palumbo *et al.,* 2001; Hilje et al., 2001; Mutwiwa *et al.,* 2005; Zlahi-Balogh *et al.,* 2006; Kumar *et al*., 2006).

Chan and Jeger (1994) reported that uprooting was most effective where plants were sparsely distributed and with minimal contact. This may also relate to young plants whose canopies are still small.

Ioannou *et al.,* (1987) recommended the use of healthy transplants, and later in 1991 reported successful control of TYLCV by timely planting. Thus, the whitefly population is low during the rainy season and high in the dry season. Careful tomato seedling protection against whiteflies in the dry season, and transplanting the beginning of the rainy season helped to avoid TYLCV infection.

Sharaf *et al.* (1986); Prabhaker *et al.* (1988); Mason *et al.* (2000); and Palumbo *et al.* (2001) managed vector populations by using chemical pest control options, such as Imidacloprid (a nicotinoid), buprofezin (a chitin synthesis inhibitor), and pyriproxyfen (a juvenile hormone analog). However, Palumbo *et al.* (2001) recommend use of cultural and biological options for controlling B.tabaci because of pest resistance to insecticides. Incidence, distribution and characteristics of major tomato leaf curl and mosaic virus diseases 22 Cohen and Antignus (1994), Mazyad *et al.* (1994), as well as Greer and Dole (2003) used cultural practices, such as

yellow traps and mulches, intercropping tomato with other crop species, and physical barriers to reduce whitefly movement.

According to Palumbo *et al.* (2001), cultural and biological pest management tactics provide the best options for controlling *B. tabaci* and overcoming the problem of insecticide resistance. As such, various cost effective measures have been reported for controlling tomato virus diseases. They include cultural practices, vector manipulation, inoculum source elimination or phytosanitation, cross-protection, use of resistant varieties or even transgenic plants, and virus or vector exclusion (Hilje et al., 2001; Lapidot and Friedmann, 2002; Greer and Dole, 2003; Rubio *et al.*, 2003; Yang *et al.*, 2004; Mutwiwa *et al.*, 2005; Kumar *et al.*, 2006; Zilahi-Balogh *et al.*, 2006; and Fuentes *et al.*, 2006).

A baseline survey was conducted in five tomato growing areas in the Ashanti region of Ghana by R. Akromah , S.K.Green, S. L. Shih, C.K.Osei in 2006, to obtain information on tomato yellow leaf curl virus diseases encountered by tomato farmers. The results of the survey indicated that male farmers within the age group of 31-40 constitute the main tomato growers. TYLCV was listed as an important disease of tomato and is causing severe yield losses in the growing areas. Farmers control measures which is mainly through spraying of chemicals is partially effective or not effective at all.

Sana (2003) in his study on farmer's knowledge of shrimp cultivation found that majority (61 percent) of the shrimp farmers had medium Knowledge following 30 percent who possessed low knowledge and a few of them (9 percent) had high knowledge. In his study, most (91 percent) of the respondents had low to medium level of knowledge. A similar finding was found by Rahman (2001).

Akther (2003) conducted a study, on comparison between knowledge and skills or women led Famer Field School (FFS) of RDRS and non-Famer Field School famers and found that almost three fourth (77.78 percent) of the FFS famers had medium knowledge category and only 11.11

percent had poor and the same percent had high knowledge categories. On the other hand, all (100 percent) of the non FFS farmers fell in the poor knowledge Category and no farmers were under medium and high knowledge categories.

Hossain (2003) found that majority (66 percent) of the farmers had medium knowledge on modern boro rice cultivation practices compared to 17 percent having both low knowledge and Islam (2002) made a study on proshika farmer's knowledge and adoption of ecological agricultural high knowledge. The study also indicates that the most (83%) of the, farmers were in medium knowledge to high knowledge categories.

Alam (2002) conducted a study on comparative analysis between knowledge and skill of the beneficiaries under two training strategies (Spot training and residential training) of RDRS and revealed that beneficiaries of both type of training differed significantly in respect of their Knowledge on training strategies. In case of Spot training, 58.34 percent beneficiaries had high knowledge, 45 percent had medium knowledge and 1.66 percent had poor knowledge. The findings also revealed that knowledge of the beneficiaries of spot training were higher than residential training.

Sarker (2004) observed that majority or three-fifth (60 percent) of the famers possessed medium knowledged on BRRI Dhan 29 while about one third (33 percent) of them possessed high knowledge and 7 percent had low knowledge. His findings showed that an overwhelming majority (93 percent) of the farmers possessed medium to high level of knowledge.

Marnun's (2002) study revealed that the majority (52.8 percent) of the farmers possessed moderate knowledge on quality rice seed production and preservation while about one-fourth (24.7 percent) possessed poor knowledge and above one-fifth (22.5 percent) possessed good knowledge.

Mannan (2001) in his study on knowledge about food and nutrition of the farmers under Proshika found that three-fourth (75 percent) of the respondents fell in the medium knowledge

category, while about one -tenth (9 percent) of them fell in low knowledge and about one-sixth (16 percent) fell in the high knowledge category. This means that overwhelming majority, (91 percent) of the respondents had medium to high level of knowledge about food and nutrition.

Haque (2002) observed that highest proportion (41.88 percent) of the farmers possessed moderately favorable attitude towards extension activities of DAE while about one-third (32.48 percent) of them had moderately unfavorable attitude towards the same. Again, 14.53 percent farmers showed strongly unfavorable attitude towards extension activities of DAE while 6.84 percent respondents possessed strongly favorable attitude towards the same. Only 4.27 percent of the farmers had neutral attitude towards extension activities of DAE. The mean value indicated that overall attitude of the fanners was slightly favorable towards DAE.

Siddique (2002) in his study on attitude of farmers towards improved winter vegetable production found that majority (64.35 percent) of the vegetables growers had moderately favorable attitude towards improved winter vegetable production while 25.74 percent had slightly favorable attitude and only 9.90 percent fell in the highly favorable attitude category. He also found that the majority (about 74 percent) of the vegetable growers showed medium to high favorable attitude.

Haque's (2002) study on attitude of rural women towards homestead agriculture in a selected area of Panchagarh district found that the most of the rural women had moderate favorable attitude in each of the five selected activities. These were 83, 78, 72 and 70 percent in poultry raising, goat rearing, fish cultivation, tree plantation and vegetable cultivation respectively.

Afrad's (2002) Study revealed that about three-fifth or majority (59.1 percent) of the farmers had favorable attitude towards vegetable cultivation while two fifth (40.9 percent) of them had moderately favorable attitude towards vegetable cultivation.

Alam's (1997) study revealed that half (50 percent) of the respondents had low use of farm practices followed by medium use (43%). Only a few (7 percent) of them had high use of improved practices.

Hasan (1996) found in his study that the highest proportion (44 percent) of the respondents perceived the existence of medium adoption, compared to high adoption (30%) and low adaptation (26%) in respect of selected agricultural technologies.

2.2 Studies related to TYLCV

The study of Asare-Bediako E, Mensah-Wonkyi D., Van der Puije G.C. and Abole E. in 2017, assessed farmers' awareness of tomato yellow leaf curl virus (TYLCV) disease and their agronomic and disease management practices in the Efutu municipality, Komenda-Edina-Eguafo-Abirem (KEEA), and Mfantseman districts which are leading tomato producing centres in the Central Region of Ghana. The study also surveyed the incidence and severity of the TYLCV disease in tomato fields across the three districts. The majority of the farmers (92.6%) were aware of the TYLCV disease and said it could cause yield losses ranging from less than 10% to over 41% but did not know the cause. The majority (60.4%) of the farmers managed the TYLCV disease in their farms mainly by applying insecticides (55.6%) and rogueing of diseased plants (43.1%). About 61% of the farmers practiced mixed cropping, and most of them cultivated tomato in both the major and minor cropping seasons, using mainly an improved form of Solanum pimpinellifolium. The highest mean disease incidence and mean disease severity indices were recorded at KEEA (52.9±2.7%, 26.89±1.2%), followed by Efutu (49.5±1.19%, 25.29±0.9%), and Mfantseman (42.1±2.7%, 21.41±0.8%) respectively.

Glick E., Levy Y., Gafni Y. (2009) found in their research that, the disease is caused by a group of viral species of the genus Begomovirus, family Geminiviridae (geminiviruses), referred to as Tomato yellow leaf curl virus (TYLCV). These are transmitted by an insect vector, the whitefly Bemisia tabaci, classified in the family Aleyrodidae. The genome of TYLCV generally consists of a single circular single-stranded (ss) DNA molecule, with only one exception in which two components were identified. It encodes six open reading frames, only

one of which codes for the coat protein (CP) that represents a building block of the viral particle. TYLCV, like all other members of the Geminiviridae, has geminate particles, apparently consisting of two incomplete T = 1 icosahedra joined together to produce a structure with 22 pentameric capsomers and 110 identical CP subunits. Close to 50 years of intensive research into TYLCV epidemics has been conducted to find solutions to the severe problem caused by this virus.

Rodrigo Soares Ramosa, Lalit Kumar, Farzin Shabanib, Marcelo Coutinho Picanço conducted a research on TYLCV and found that, large regions are projected to be suitable for TYLCV in areas of suitability for *B. tabaci* and optimal for open field tomato cultivation. In the predictions, most areas with optimal conditions for *S. lycopersicum* and suitable for *B. tabaci* will be under medium suitability for TYLCV under climate change scenarios.

Arman Hasan Anik, Fatema Begum, F. M. Aminuzzaman, Md. Jonaid Hossain, Nishan Chakma, and S. M. Nazmus Sakib Shahin in 2020 conducted a research on TYLCV. They used two popular BARI released variety namely BARI Tomato14 and BARI Tomato-16 that was transplanted at three different planting times (1st planting time on 1st November 2nd planting time on 15th November and 3rd planting time on 1st December 2016). The lowest percent TYLC disease incidence (12.42%) and percent disease severity (15.37%) were found in 3rd planting (1st December) in BARI Tomato-16 variety, respectively. Under the study, considering the percentage of TYLC disease incidence and severity, BARI tomato-16 on 1st December showed better performance comparing others. The 3rd planting (1st December) and BARI Tomato-16 variety were found to have the highest yield (77.23 ton/ha) and promising the lowest level of percentage of disease incidence (12.42%) and percent disease severity (15.37%) against TYLCV. A strong positive correlation was obtained between the whitefly population and the percent disease incidence of TYLCV.

TYLCV is transmitted by a whitefly (Bemisia tabaci Gennadius) of the Family Aleyrodidae (Cohen and Nitzany, 1966; Nakhla *et al.*, 1978; Gerling and Mayer, 1995). Bemisia tabaci occurs in biotypes A and B. Biotype B is more common than A and is regarded by some as a

separate species designated B. argentifolii (Bellows *et al.*, 1994). Others continue to regard it as a biotype of B. tabaci, even though there are many more biotypes, which include biotype Q (Demichelis *et al.*, 2000).

While assessing other methods of TYLCV transmission, Makkouk (1979) established that direct contact between plants, natural root grafting through adjacent roots, seed infection, and soil contamination are not effective in transmitting TYLCV, and that the only efficient method of transmission is by *B. tabaci* or *B. argentifolii.*

Epidemiological studies by Moustafa (1991), in the semi-tropical climatic zone of Egypt, indicated that at the beginning of spring and early summer (February - April), when tomato plants have just established, TYLCV incidence is very low. The latter becomes high towards the end of summer (September – mid-October), and then coincides with peak whitefly population density (Riley *et al.*, 1995). This is followed by high TYLCV incidence and severe damage in the fall (autumn) when production losses rise to 80% and almost all plants are infected. Similarly, Cohen and Antignus (1994) observed that in the Jordan Valley, the spread of TYLCV was significantly correlated with B. tabaci population size. As in Egypt, peak whitefly population occurred between the first week of September and Mid-October. In Tanzania, TYLCV symptoms and whitefly vector presence are reported to be most common during November to February (Nono-Womdim *et al.*, 1996). Another factor contributing to high incidence of TYLCV is proximity to old host crop fields.

Mazyad *et al.* (1994) found that adjacent old fields of vegetables and other field crops present at tomato planting play a big role in harbouring whiteflies, which eventually infest tomatoes. Similar observations were made in Egypt, Cyprus, Lebanon, Jordan, Saudi Arabia and Israel (loannou *et al.*, 1991; Mazyad *et al.*, 1986; Makkouk *et al.*, 1979). Although some whitefly vector-host studies have been conducted in relation to Cassava mosaic geminiviruses (CMGs) in Uganda (Legg, 1996), there is a need to establish the relationship between whitefly vector and transmitted TYLCV in order to develop sound TYLCV management options.

2.3 Conceptual Framework of the Study

In scientific research, the conceptual framework is selecting and measuring variables. A properly constructed research hypothesis contains a "dependent variable" and "independent variable

The conceptual framework of the study, has been formulated as shown in figure 2.1.

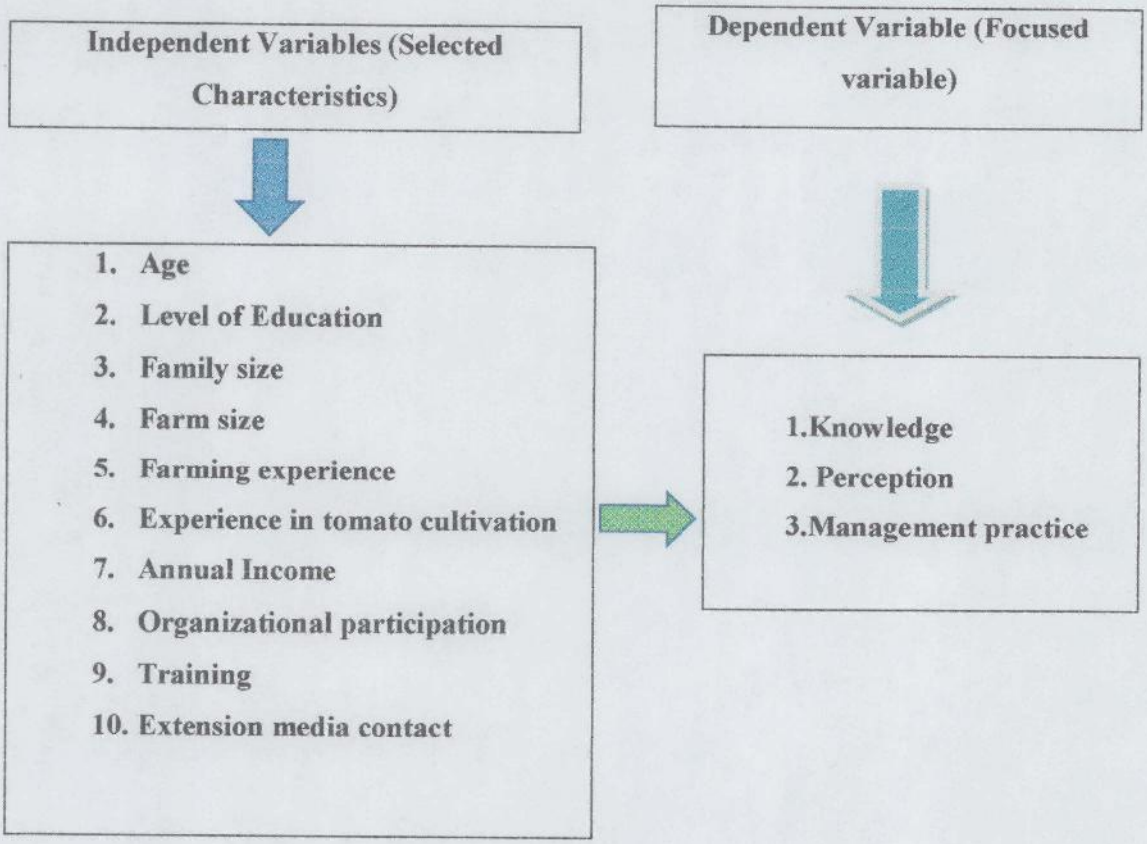

Fig. 2.1: Conceptual model showing relationship between knowledge, perception, management practice and the farmers' selected characteristics (Independent Variables)

CHAPTER III
METHODOLOGY

Methodology refers to the overarching strategy and rationale of a research project. It involves studying the methods used in field and the theories or principles behind them, in order to develop an approach that matches a research objectives. Importance of methodology in conducting any research cannot be neglected. Research methodology simply refers to the practical "how" of any given piece of research. More specifically, it's about how a researcher systematically designs a study to ensure valid and reliable results that address the research aims and objectives. Keeping this point in view, the researchers took utmost care for using proper methods in all aspect of this investigation.

Research methodology is a systematic way to solve a research problem. It may be understood as a science of studying how research is done (Kothari, 1990). The present study was a field survey on farmers' knowledge, perceptions and management practices of Tomato yellow leaf curl virus disease at Dumuria Upazila in Khulna division. The methods and procedures followed in conducting this study have been discussed in this chapter.

3.1 Design of the study

An ex-post facto explanatory cross-sectional research design was used for the study. The study was quasi-experimental in nature and tried to predict the relationship of the selected characteristics of the farmers with their knowledge, perception and management practices of tomato yellow leaf curl virus.

3.2 Location of the study area

The study was conducted at three villages under Dumuria Upazila in Khulna district. The researcher deliberately selected three villages of Dumuria Upazila from Khulna district namely Kulbaria, Gobindakathi and Baratia moddhopara under Dumuria Upazila.

Figure3.1 Map of Dumuria Upazila showing the study area

3.3 Population and sampling

The tomato grower of the selected three villages were treated as population of this area. Out of them 87 farmers were selected purposively as sample of the study. The distributions of sample farmers in the three selected villages are shown in the Table 3.1.

Table 3.1 Sampling of the respondents

Upazilla	Name of the villages	Number of farmers (Respondents)
Dumuria	Kulbaria	29
	Gobindakathi	29
	Baratia Maddhopara	29
Total		87

3.4 Preparation of questionnaire

A questionnaire was used as the research instrument in order to collect relevant information from the respondents. A questionnaire was prepared for data collection in Bengali keeping the objectives of the study in view. The questionnaire contained both closed and open ended questions. Simple and direct questions were included into the questionnaire. Questions were included in the schedule to collect data on the selected variables. Based upon the pretest experience, necessary correction, addition, alteration and re-arrangement were made in the questionnaire before it was run for final data collection. During modification of the questionnaire the researchers incorporated valuable suggestions from her research supervisor and co-supervisor into it. English version of the same questionnaire is presented in Appendix A.

3.5 Method and time of data collection

The researchers collected data from the farmers through face to face interview during their free time. Sub Assistant Agriculture Officers (SAAO) of that block helped and co-operated the researchers in data collection. During data collection, the researchers made necessary efforts

to establish rapport with the farmers so that they became free to answer the questions and statements included in the interview schedule. The researchers explained and clarified the questions and statements as much as possible so that the farmers could easily understand and answer the questions correctly. All the data in the interview schedule was collected from the farmers and checked properly. The farmers were very cooperative during interview.

The researchers collected data for the study from 16 January to 15 February 2022. During this time the researchers had to made several visits for collecting valid and reliable data from the respondents.

3.6 Specification and measurement of the variables

3.6.1 Specification of variables

Specification of variables is an essential task for any descriptive social research. A variable is any characteristic which can assume varying or different values in successive individual cases. At least two relevant variables, an independent and a dependent variable, are included in a well-organized study. An independent variable is a variable that is changed to determine the link to a phenomena. As the experiment introduces, eliminates, or modifies the independent factors, the dependent variable changes (Townsend, 1953). The independent variables were personal, socio-economic characters and knowledge, perception and management practices on TYLCV of the respondents. The characteristics were age, educational qualification, family size, farm size, Farming experience, experience in tomato cultivation, annual family income, organizational participation, extension media contact, training exposure. The dependent (focus) variable of the study was KPM (Knowledge, perception and management Practices) of the farmers selected characteristics about tomato yellow leaf curl virus.

3.6.2 Measurement of independent variables

3.6.2.1 Age

Age of the respondents was determined by counting their age from birth to the time of data collection according to their statement. It was expressed in terms of complete years. It was scored one for each year of their age. It is the item no. 1 in the interview schedule (Appendix

A). According to age range the farmers were classified into three categories as shown in table 3.2.

Table 3.2 Categories of the respondents according to their age

Categories	Age limits (years)
Young aged	Up to 35
Middle aged	36 to 50
Old aged	>50

3.6.2.2 Educational qualification

Formal education was regarded as educational qualification of a respondent. The level of education was measured by the years required to achieve formal education. A score of one (1) was given to the respondents for each year of schooling on the basis of passed class. A score of zero (0) was given to those who has no formal education and can't read and write. Thus the score of a respondent on educational qualification was determined from response to item No.2 in the interview schedule (Appendix A). On basis of educational qualification, respondents were classified into following categories showing in table 3.3.

Table 3.3 Categories of the respondents according to their educational qualification

Categories	Score (Year of schooling)
Illiterate	0
Primary level	1-5
Secondary level	6-10
Higher secondary level	11-12
Graduate	13-16

3.6.2.3 Family size

Family size was determined by the total number of family members of a respondent including himself, his wife, children and other dependents. Score of a farmer on family size was counted by the actual number of his family members. Family size belongs to item No.3 in the interview schedule (Appendix A). On basis of family size, respondents were classified into following categories showing in table 3.4.

Table 3.4 Categories of the respondents according to their family size

Categories	No of family members
Small sized family	1 – 4
Medium sized family	5 -6
Large sized family	7-15

3.6.2.4 Farm size

Farm size refers to the total area of land owned by a respondent including homestead area. It also includes the land obtained from others on share cropping/borga or taken from others on lease. The area was being estimated in terms of full of benefits to the farmers.

The farm size was calculated using following formula,

$$FS = A_1 + A_2 + \frac{1}{2}(A_3 + A_4) + A_5 - A_6 + A_7$$

Where,

FS = Farm size

A_1 = Homestead

A_2 = Own land under own cultivation

A_3 = Land taken from others on borga

A_4 = Land given to others on lease

A_5 = Land taken from others on lease

A_6 = Land given to others on lease

A_7 = Others

The farm size was recorded in local unit and then it was converted to hectare. Farm size is shown in item No. 4 in the Interview schedule (Appendix A). On the basis of farm size, farmers were classified into five categories which are shown in following Table 3.5 (Anonymous, 1999).

Table 3.5 Categories of the respondents according to their farm size

Categories	Score (ha)
Landless farmers	<0.02
Marginal farmers	0.02 -0.20
Small farmers	0.21- 1.0
Medium farmers	1.01-3.0
Large farmers	>3.0

3.6.2.5 Experience on farming

Experience on farming of the respondents were measured by the length covered from his stating years in cultivation to the time of interview on the basis of his statement. A score of one (1) was assigned for each year of his farming experience. It appears in item No. 4 of interview schedule (Appendix A).The respondents were grouped into different 4 categories based on experiences in farming.

Table 3.6 Categories of respondents according to their experience in farming

Categories	Score (years)
Low experience	10
Medium experience	11 – 20
High experience	> 20

3.6.2.6 Tomato cultivation experience of the respondents

Experience on tomato cultivation the respondents were measured by the length covered from his starting years in tomato cultivation to the time of interview on the basis of his statement. A score of one (1) was assigned for each year of his tomato cultivation experience. It appears in item No. 5 of interview schedule (Appendix A).The respondents were grouped into different 4 categories based on experiences for tomato farming.

Table 3.7 Categories of respondents according to their experience on tomato cultivation

Categories	Score (years)
Low experience	10
Medium experience	11 – 20
High experience	> 20

3.6.2.7 Annual income

Annual income of a farmer was estimated by considering total earnings in the last year from different sources viz. agriculture, business, service, day laborers and others. Annual family is included in the interview schedule as item No.5 (Appendix A). The respondents were classified into following categories according to annual income as shown in Table 3.6.

Table 3.8 Categories of the respondents according to their annual income

Categories	Taka (BDT)
Low income	≤150000
Medium income	150001-300000
High income	>300000

3.6.2.8 Organizational participation

Organizational participation of a respondent was measured on the basis of number of organization he/she involved and his/her position in particular organization. For example, if a respondent involved in one organization his organizational participation score is accordingly as no involvement (0), general member (1), executive member (2) and executive officer (3). Based on organizational participation scores, the respondents were grouped into following categories as shown in Table 3.9.

Table 3.9 Categories of the respondents according to their organizational participation

Categories	Score
No participation	0
Low participation	1 -5
Medium participation	6 – 10
High participation	>10

3.6.2.9 Extension media contact

In this study, the extension media contact score was computed for each respondent on the basis of the extent of his contact with selected media as ascertained from his responses to item No. 9 in the interview schedule (Appendix A). Each respond was asked to indicate the extent of his

contact with its extension such as often, sometimes, seldom and never and a score of 3, 2, 1 and 0 was assigned to these categories respectively. Based on extension media contact score, the respondents were grouped into four categories as shown in Table 3.10

Table 3.10 Categories of respondents according to their extension media contact

Categories	Score
Low contact	1-8
Medium contact	9 -16
High contact	17 – 24
Very high contact	>24

3.6.2.10 Training exposure

Farmers training score was determined by the number of training s/he received by without considering duration of training. Based on training score, the respondents were classified into following categories as shown in Table 3.11.

Table 3.11 Categories of respondents according to their training exposure

Categories	Score (no of training)
No training	0
Low training	1
Medium training	2
High training	3

3.6.3 Measurement of dependent variables

3.6.3.1 Knowledge on TYLCV

Knowledge on TYLCV disease of the farmers indicate their practical knowledge on TYLCV. To determine knowledge of farmers 12 questions were asked to each farmer. The questions covered different aspects on TYLCV disease. Each question was assigned by 2 marks. If a farmer can answer all of those questions he/she will get 24 marks. If he/she could not answer any of the questions he/she will get 0. So, the range pertains to 0 to 24.

Table 3.12 Categories of respondents according to their knowledge on TYLCV

Categories	Score
No	0
Low	1-7
Medium	8-15
High	16-24

3.6.3.2 Perception on TYLCV Disease

Perception on TYLCV refers to their reactions, positive as well as negative reaction on GAP. The score could range from 15 to 75. Likert scale was used to measure perception as follows to each statement is given below:

Table 3.13 Categories of respondents according to their perception on TYLCV

Categories	Score
Less clear	<18
Moderately clear	19-36
Clear	37-56
Highly clear	57-75

3.6.3.3 Measurement of management practices of TYLCV disease

There was 15 management practices to measure their extent of management practice against TYLCV virus. All the management practice criteria (during pre-sowing, standing crop and post-harvest) were scored as Table 3.14.

Table 3.14 Score of Extent of Practice

Extent of practice	Score
Frequently	3
Occasionally	2
Rarely	1
Not at all	0

3.6.3.3.1 Management Practice Index of TYLCV

The extent of practicing each management practice was determined based on practice index. The disease management practice score was determined by using the following formula,

$PS = N1 \times 3 + N2 \times 2 + N3 \times 1 + N4 \times 0$

Where,

PS= Practice score

N1= Number of respondents did the practice frequently

N2= Number of respondents did the practice occasionally

N3= Number of respondents did the practice rarely

N4= Number of respondents did the practice not at all

The possible range of practice score was 0 to 261.

For example, among 100 respondents 55, 25, 12 and 8 respondents indicate the extent of a management practice as frequently, often, occasional, rarely and not at all respectively. Thus the PS for that practice is

$$PS = 55\times3+25\times2+12\times1+8\times0$$
$$= 165+50+12+0 = 227$$

After determination of PS, the practice index was determined by following formula

$$(\%)\ \text{Management Practice Index} = \frac{\text{observed management practice score}}{\text{possible highest management practice score}} \times 100$$

3.6.3.4 Rank

The rank of a Management Practice was determined based on the (%) severity of the Management Practice. The Practice which obtained highest (%) severity hold the first rank and then the second highest (%) severity hold the second rank and so on.

3.7 Data tabulation

All the interview schedules were prepared for data tabulation after completing the field study. Collected data was summarized and inspected thoroughly. A master sheet was prepared to tabulate the data by transferring all the individual variables in order to meet the objectives of the study.

3.8 Data processing

During data processing, appropriate scoring technique was applied in conversion all the qualitative data into quantitative form. Local units of measurements were converted into standard units. In case of some variables, proper indices and scales were made through the simple accumulation of score assigned to individual or pattern of attributes. Indices and scales were considered the efficient instruments for data reduction and analysis. All personal characteristics were categorized and arranged in simple tables for interpretation and discussion. Number, frequency, percentage and correlation were used for statistical description.

Warburton, H. *et al*, (2002), found in their research that, only 2% of farmers were aware that tomato leaf curl virus (ToLCV) was transmitted by a whitefly vector, *Bemisia tabaci*. A similarly small number of farmers knew that ToLCVD was caused by a virus, whilst 86% of farmers believed that it was caused by high temperatures.

4.1.2 Farmers perception on TYLCV disease

Table 4.2 shows that, most of the respondents (57.5%) had less clear perception on tomato yellow leaf curl virus disease followed by 35.6% very less clear perception and only 6.9% had moderately clear perception. No respondents were found having highly clear perception.

Table 4.2 Distribution of the respondents on the basis of their obtained perception score regarding TYLCV

Categories	Scores	Respondents (N=87)		Mean±SD	Range	
		Number	%		Min.	Max.
Very Less clear	<18	31	35.6	27.34±7.50	15	52
Less clear	18-36	50	57.5			
Moderately Clear	37-56	6	6.9			
Highly Clear	57-75	0	0			

The perception on TYLCV disease score of the farmers ranged from 15 to 52 with a mean and standard deviation of 27.34 and 7.50 respectively. In Table 4.2 the distribution of the farmers on the basis of their obtained perception score regarding TYLCV is shown.

4.1.3 Index of farmer on individual perception statement regarding TYLCV disease

From the Table 4.3 we can observe that, between the problem related and solution related perception the problem related perception ranked 1st. that means the respondents had more clear perception on the problem related to tomato disease.

Table 4.3 Distribution of farmer on individual perception statement regarding TYLCV disease

Statements	Score	Index (%)	Rank
a. Problem related			
1. Tomatoes are more susceptible to diseases	141	62.67	10th
2. Lack of quality seed	202	72.14	6th
3. Solely dependent on chemical control to control white fly	216	84.71	**1st**
4. Virus diseases are difficult to control	143	69.76	8th
5. TYLCV insect vector has a wide range of host.	86	57.33	11th
6. TYLCV is very destructive disease	204	72.86	4th
7. TYLCV spreads easily	130	78.79	3rd
Total of problem related statements	**1120**	**67.87**	**1st**
b. Solution related			
1. Clean cultivation can control TYLCV	213	67.62	9th
2. Rouging of infected plants can control TYLCV	143	52.96	14th
3. Crop rotation can help in preventing diseases	223	82.59	2nd
4. Bio-pesticides are eco-friendly	141	72.31	5th
5. Controlling the vector can control the disease	126	52.50	15th
6. Cultivation of resistant variety restrict disease spread	155	70.45	7th
7. Using of pheromone trap helps in controlling white fly(vector)	135	54	13th
8. Cultivation on alternate time may help in controlling disease	110	56.41	12th
Total of solution related statement	**1246**	**66.81**	**2nd**

Perception on chemical control ranked 1st, which was 84.71%, perception on crop rotation 2nd (82.59%), perception on spreading of TYLCV ranked 3rd (78.79%) and the last ranked was controlling the vector shown in Table 4.3

E. Asare-Bediako *et al.*, in 2017, found in their study that, the majority of the farmers (92.6%) were aware of the TYLCV disease and said it could cause yield losses ranging from less than 10% to over 41% but did not know the cause.

4.1.4 Management Practices of the farmers on TYLCV disease

Majority (84.8%) of the farmers had medium management practices and 15.2% of them had low management practices followed by high level of management practices (4.50%) shown in Table 4.4

Table 4.4 Distribution of the respondents on the basis of their obtained management practices score regarding TYLCV

Categories	Score	Respondent (N=87)		Mean±Sd	Range	
		Number	%		Min.	Max.
No	0	0	0	25.69±5.79	13	38
Low	1-15	2	15.2			
Medium	16-30	65	84.8			
High	31-45	20	4.50			

The table 4.4 presents distribution of the farmers based on the management practices on TYLCV in which disease score of the farmers ranged from 13 to 38 with a mean and standard deviation of 25.69 and 5.79 respectively.

4.1.5 Index of farmers management practices of TYLCV disease

Among all management practices, maintaining Proper sanitization during intercultural operation ranked 1st and the percentage was 84.67, crop rotation ranked 2nd and percentage was 81.19, use of pesticide ranked 3rd and the percentage was 78.16 and the last (15th) ranked

was using indigenous methods (Spreading ashes/ Spray of neem water etc.) and the percentage was 10.73 shown in table 4.5

Table 4.5 Index of farmer on individual management practices on TYLCV disease

Management practices	Score	Index (%)	Rank
a. Pre-sowing:			
i. Soil treat	139	53.26	10th
ii. Use of healthy seeds (Free from insects and disease)	151	57.85	9th
iii. Cultivation of resistant variety	128	49.04	13th
iv. Crop rotation	190	81.19	2nd
v. Maintains cropping season	194	74.33	4th
Total of pre-sowing management practices	**802**	**62.75**	**1st**
b. Standing crop			
i. Weed management (Prevention, Eradication and Control)	146	63.20	6th
ii. Maintains Proper sanitization during intercultural operation	221	84.67	1st
iii. Follows IPM techniques	136	52.11	12th
iv. Rouging of infected plant parts	186	71.26	5th
v. Use of pheromone trap	109	52.66	11th
vi. Use of pesticide	204	78.16	3rd
vii. Perching in the field for insect control	152	58.34	8th
viii. Other indigenous methods (Spreading ashes/Spray of neem water etc.)	28	10.73	15th

Total of standing crop management practices	**1078**	**53.79**	**2nd**
c. Post-harvest:			
i. Harvest at mature stage	163	62.45	7th
ii. Burning of crop residue after harvesting	109	43.25	14th
Total of post-harvest management practices	**272**	**53.02**	**3rd**

Among the pre-sowing, standing crop and post-harvest management practices the pre-sowing ranked 1st followed by standing crop and post-harvest. The highest scored management practice was maintaining proper sanitization during intercultural operation which was scored 221 and the last one was using indigenous methods (Spreading ashes/Spray of neem water etc.) scored 28 only shown in Table 4.5

E. Asare-Bediako et al. in their study found that, the majority (60.4%) of the farmers managed the TYLCV disease in their farms mainly by applying insecticides (55.6%) and rogueing of diseased plants (43.1%)

4.2 Selected characteristics of the respondents

4.2.1 Age of the respondents

The age of the farmers was markedly varied. The mean and standard deviation of age are 41.04 and 11.09 respectively. Based on age, the farmers classified into different categories are shown in Table 4.6

Table 4.6 Distribution of the respondents according to their age

Categories	Score (Year)	Respondent (N=87)		Mean±Sd	Range	
		Number	%		Min.	Max.
Young	≤35	32	36.8	41.04±11.09	22	62
Middle aged	36-50	37	42.5			
Old	>50	18	20.7			

Data furnished in the Table 4.6 revealed that the maximum number of respondents were middle aged 42.5% as compared to 36.8% being young and 20.7% old aged. The age of the respondents was ranging from 22 to 62.

4.2.2 Educational qualification of the respondents

The educational qualification of the respondents ranged from 0 to 16 with mean and standard deviation of 5.22 and 3.73 respectively. On the basis of education, the respondents were categorized into five categories as shown in Table 4.7

Table 4.7 Distribution of the respondents according to educational qualification

Categories	Score (Year of schooling)	Respondent (N=87)		Mean±Sd	Range	
		Number	%		Min.	Max.
Illiterate	0	13	14.9	5.22±3.73	0	16
Primary	1-5	38	43.7			
Secondary	6-10	29	33.3			
Higher secondary	11-12	5	5.7			
Graduate or above	13-16	2	2.3			

Data presented in the Table 4.7 demonstrate that highest proportion (43.7%) of the respondents had primary level of education followed by illiterate (14.9%), secondary (33.3%), graduate or above (2.3%) and rest (5.7%) higher secondary.

4.2.3 Family size of the respondents

Family size of the respondents ranged from 2 to 9, with a mean of 4.74 and standard deviation 1.82. Based on their family size scores, the respondents' families were classified into three categories. The distribution of the respondents according to their family size is shown in Table 4.8

Table 4.8 Distribution of the respondents according to their family size

Categories	Score (Year)	Respondent (N=87)		Mean±Sd	Range	
		Number	%		Min.	Max.
Small	1-4	30	34.5	4.74±1.82	2	9
Medium	5-6	41	47.1			
Large	7-15	16	18.4			

Data presented in Table 4.8 show that majority (47.1 %) of the respondents belonged to the medium sized family while (18.4%) and (34.5%) of the respondents belonged to large size family and small size family respectively. The minimum and maximum no. of the family members ranged from 2 to 9.

4.2.4 Farm size of the respondents

Farm sizes of the respondents were classified into five categories. Among them small farmers occupied 75.9%, 19.5% were medium, while only 4.5% were marginal and there had no large-scale farmer also no farmers were landless. The minimum and maximum value of the farm size was ranging from 0.18 to 1.91ha. Where the mean and standard deviation value was 0.73 and 0.37 respectively. The distribution of the farmers according to their farm size is shown in Table 4.9

Table 4.9 Distribution of the respondents according to their farm size

Categories	Score (ha)	Respondents (N=87)		Mean±SD	Range	
		Number	Percentage		Min.	Max.
Landless	<0.02	0	0	0.73±0.37	0.18	1.91
Marginal	0.02-0.20	4	4.5			
Small	0.21-1.00	66	75.9			
Medium	1.01-3.00	17	19.5			
Large	>3.00	0	0			

4.2.5 Farming experience of the respondents

The farming experience score of the respondents ranged from 1 to 30 with a mean and standard deviation of 14.00 and 8.27 respectively. Based on farming experience, the respondents were classified into low (1-10), medium (11-20) and high (>20) categories as shown in Table 4.10

Table 4.10 Distribution of the respondents according to their farming experience

Categories	Score (Year)	Respondent (N=87)		Mean±Sd	Range	
		Number	%		Min.	Max.
Low experience	1-10	34	39.1	14.00±8.27	1	30
Medium experience	11-20	32	36.8			
High experience	>20	21	24.1			

Table 4.10 indicate that highest proportion (39.1%) of the respondents were short experienced in farming followed by medium experience (36.8%) and rest (24.1%) respondents had low experience.

4.2.6 Tomato cultivation experience of the respondents

Tomato cultivation experience of the respondents was classified into three categories. The mean and standard deviation was 11.12 and 7.42 respectively. The distribution of the respondents according to their chili farming experience is shown in Table 4.11

Table 4.11 Distribution of the respondents according to their tomato cultivation experience

Categories	Score (Year)	Respondent (N=87)		Mean±Sd	Range	
		Number	Percentage		Min.	Max.
Low experience	1-10	44	50.6	11.12±7.42	1	28
Medium experience	11-20	25	28.7			
High experience	21-40	18	20.7			

From the above table 4.11 it is shown that most of the farmers (50.6%) has low experience and medium experience 28.7% where highly experienced farmer is only 20.7%. The tomato cultivation experience score of the farmers ranged from 1 to 28.

4.2.7 Annual family income of the respondents

Annual family income of the respondents ranged from 74000 to 387000 with a mean of 191425.3 and standard deviation of 77263.2. The distribution of the respondents according to their annual family income is shown in Table 4.12

Table 4.12 Distribution of the respondents according to their annual family income

Categories	Scores (Tk)	Respondents (N=87)		Mean±SD	Range	
		Number	%		Min.	Max.
Low income	≤150000	35	40.20	191425.3±77263.2	74000	387000
Medium income	150001-300000	44	50.6			
High income	>300000	8	9.2			

Data presented in Table 4.12 reveals that the majority (50.6%) of the respondents had medium income while only 9.2% had high income and 40.20% of them had low income.

4.2.8 Organizational participation of the respondents

The observed organizational participation score of the respondents ranged from 0 to 6 with a mean of 2.14 and standard deviation of 1.77 respectively. The distribution of the respondents according to organizational participation their score is presented in Table 4.13

Table 4.13 Distribution of the respondents according to their organizational participation

Categories	**Score**	**Respondent (N=87)**		**Mean**	**±SD**	**Range**	
		Number	**%**			**Min**	**Max**
No	0	19	21.8	2.14	1.77	0	6
Low	1-5	64	73.6				
Medium	6-10	4	4.6				

Data contained in Table 4.13 indicate that majority (73.6%) of the respondents had low level of organizational participation. On the contrary, 21.8% of the respondents had no organizational participation and only 4.6% had medium organizational participation.

4.2.9 Extension media contact of the respondents

The extension contact score of the respondents ranged from 5 to 20 with a mean and standard deviation of 10.40 and 3.67 respectively. The distribution of the respondents based on their extension contact is shown in Table 4.14

Table 4.14 Distribution of the respondents according to their extension media contact

Categories	Score	Respondent (N=87)		Mean±Sd	Range	
		Number	%		Min.	Max.
No contact	0	0	0	10.40±3.67	5	20
Low	1-8	36	41.4			
Medium	9-16	47	54.0			
High	17-24	4	4.6			

Most (54%) of the respondents had medium scale extension media contact followed by low scale extension media contact (41.4%) and high extension contact (4%). None of respondents belonged to "no" contact categories shown in Table 4.14

4.2.10 Training exposure of the respondents

The training exposure score of the respondents ranged from 0 to 3 with a mean of 1.16 and standard deviation of 0.83. The distribution of the respondents according to training exposure participation score is presented in Table 4.15

Table 4.15 Distribution of the respondents according to their training exposure

Categories	Score	Respondent (N=87)		Mean±Sd	Range	
		Number	%		Min.	Max.
No	0	21	24.1	1.16±0.83	0	3
Low	1	34	39.1			
Medium	2	29	33.3			
High	>2	3	3.4			

Data furnished in Table 4.15 represents that the highest proportion (39.1%) of the respondents belongs to low training, while 33.3% respondents were under medium training exposure category followed by 24.1% in no training and 3.4% in high training exposure category. Ahmed and Hossain (2018) found a non-significant relationship between training exposure and farmer's knowledge.

4.3 Relationship between the selected characteristics of the farmers and their knowledge, Perception and management practices of TYLCV

Coefficient of correlation was computed in order to explore the relationship between the selected characteristics of the farmers and their knowledge, perception and management practices (KPM) on Tomato Yellow Leaf Curl virus disease of tomato. The selected characteristics of the farmers constituted independent variables and the KPM constituted the dependent variable of the study. This section clarify the relationship between the independent variable of the respondents and the dependent variable described. Pearson's product moment co-efficient of correlation(r) was used.

Table 4.16 Computed coefficient of correlation (r) and spearman rank correlation between the selected characteristics of the respondents and their focused variables.

Independent variable (selected characteristics)	Dependent variable (focus variable)		
	Knowledge	Perception	Management Practices
Age	0.072	-0.015	-0.045
Educational Qualification	-0.058	-0.067	-0.115
Family size	-0.109	-0.068	-0.185
Farm size	0.277**	0.003	-0.072
Farming experience	-0.053	-0.019	-0.030
Experience in tomato cultivation	-0.050	0.11	-0.043
Annual family income	0.326**	0.074	0.005
Organizational participation	0.225*	0.31	0.062
Extension media contact	0.497**	0.220*	-0.61
Training	0.275**	0.170	0.167

NS= Non-significant **Correlation is significant at the 0.01 level (2-tailed) * Correlation is significant at the 0.05 level (2-tailed).

Data presented in Table 4.16 show that among the 10 selected characteristics of the respondents' farm size, annual family income, organizational participation, extension media contact and training exposure of the respondents showed a significant positive relationship with their knowledge on TYLCV disease. It means that with the increase of farm size, organizational participation, annual family income, extension media contact and training exposure; the knowledge of the respondents also increases. Age, educational qualification,

family size, farming experience and experience in tomato cultivation showed a non-significant relationship with their extent of knowledge.

Extension media contact showed a significant positive relationship with the perception of the respondents on the disease. Age, educational qualification, family size, farm size, farming experience, experience in tomato cultivation, annual family income, organizational participation and training exposure showed non-significant relationship with respondents' perception on TYLCV.

All of the 10 characteristics of age, educational qualification, family size, and farm size, farming experience, experience in tomato cultivation, annual family income, organizational participation, extension media contact and training exposure showed non-significant relationship with farmer's management practices of TYLCV disease.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

The prime purpose of the study is to investigate and elucidate farmers' knowledge, perception and management practices of tomato yellow leaf curl virus disease. The study was conducted at three villages of Dumuria upazila in Khulna district. Data were collected from the selected 87 respondents through personal interview during 16 January to 15 February, 2022. The collected data were compiled analyzed and summarized through SPSS software.

5.1 Summary of findings

5.1.1 Knowledge on TYLCV disease

Most of the farmers (55.2%) has medium knowledge followed by low (34.5%) and high (10.3%) knowledge about tomato yellow leaf curl virus (TYLCV) disease.

5.1.2 Perception on TYLCV disease

Majority (57.5%) of the respondents had moderately clear perception on the disease. 35.6% of the farmers had less clear perception and only 6.9% of them had clear perception on the TYLCV disease, while none of them had highly clear perception.

5.1.2.1 Level of perception (rank order) of individuals on TYLCV disease

There were two kinds of statements to find out the level of perception in which problem related perception was ranked 1st and at the 2nd position was the solution related perception on TYLCV disease. Among all of the 15 statements under problem and solution related statements, perception on chemical control ranked 1st, perception on crop rotation ranked 2nd, perception on TYLCV spread ranked 3rd and the last or 15th ranked perception was on controlling the vector to control the disease.

5.1.3 Management Practices on TYLCV disease

Majority (84.8%) of the farmers followed medium management practices and 15.2% of them followed low management practices. None of them found following high management practices.

5.1.3.1 Level of management practices (rank order) of individuals on TYLCV disease

To measure their level of management practices there were 3 category management practices named pre-sowing, standing crop and post-harvest management practices in which the pre-sowing ranked 1st, standing crop ranked 2nd and post-harvest management practices ranked 3rd. under the 3 category there was 15 management practices, in which maintaining proper sanitization during intercultural operation ranked 1st, Crop rotation ranked 2nd, Use of pesticide ranked 3rd and the 15th or the last one was using other indigenous methods (Spreading ashes/Spray of neem water etc.).

5.1.4 Relationship between the selected characteristics of the farmers and their knowledge, perception and management practices of TYLCV

Farm size, annual family income, organizational participation, extension media contact and training exposure of the respondents showed a significant positive relationship with their knowledge on TYLCV disease. Age, educational qualification, family size, farming experience and experience in tomato cultivation showed a non-significant relationship with their extent of knowledge.

Extension media contact showed a significant positive relationship with the perception of the respondents on the disease. Age, educational qualification, family size, farm size, farming experience, experience in tomato cultivation, annual family income, organizational participation and training exposure showed non-significant relationship with respondents' perception on TYLCV.

All of the 10 characteristics of age, educational qualification, family size, and farm size, farming experience, experience in tomato cultivation, annual family income, organizational participation, extension media contact and training exposure showed non-significant relationship with farmer's management practices of TYLCV disease.

5.1.5 Selected characteristics of the farmers

5.1.5.1 Age

Maximum number of respondents were middle aged 42.5% as compared to 36.8% being young and 20.7% old aged. The age of the respondents was ranging from 22 to 62.

5.1.5.2 Educational qualification

Highest proportion (43.7%) of the respondents had primary level of education followed by illiterate (14.9%), secondary (33.3%), graduate or above (2.3%) and rest (5.7%) higher secondary.

5.1.5.3 Family size

Majority (47.1 %) of the respondents belonged to the medium sized family while (18.4%) and (34.5%) of the respondents belonged to large size family and small size family respectively. The minimum and maximum number of the family members ranged from 2 to 9.

5.1.5.4 Farm size

Small farmers occupied 75.9%, 19.5% were medium, while only 4.5% were marginal and there had no large-scale farmer also no farmers were landless.

5.1.5.5 Farming experience

The highest proportion (39.1%) of the respondents were short experienced in farming followed by medium experience (36.8%) and rest (24.1%) respondents had low experience.

5.1.5.6 Farming experience in tomato cultivation

Most of the farmers (50.6%) had low experience and 28.7% were medium experienced, where highly experienced farmer was only 20.7%. The tomato cultivation experience score of the farmers ranged from 1 to 28.

5.1.5.7 Annual income

The majority (50.6%) of the respondents had medium income while only 9.2% had high income and 40.20% of them had low income.

5.1.5.8 Organizational participation

Majority (73.6%) of the respondents had low level of organizational participation. On the contrary, 21.8% of the respondents had no organizational participation and only 4.6% had medium organizational participation.

5.1.5.9 Extension media contact

Most (54%) of the respondents had medium scale extension media contact followed by low scale extension media contact (41.4%) and high extension contact (4%). None of respondents belonged to "no" contact categories.

5.1.5.10 Training exposure

The highest proportion (39.1%) of the respondants belongs to low training, while 33.3% respondants were under medium training exposure category followed by 24.1% in no training and 3.4% in high training exposure category.

5.2 Conclusion

- Tomato yellow leaf curl virus may be considered as a threat to all tomato producer who has a little or no knowledge on the disease and who has not clear perception on the prevalence of the disease.
- Most (55.2%) of the farmers had medium knowledge on TYLCV disease. The perception on TYLCV of 57.5% is moderately clear and according to their statements their perception on chemical control ranked 1st, which may have a negative impact on the prevalence of the tomato yellow leaf curl virus disease. Major portion (84.8%) of the farmers had medium management practices. Among the 15 selected management practices, the mostly followed practice is proper sanitization during intercultural operation. This is a quite good practice to ensure the removal of any disease establishment.

5.3 Recommendation

- Farmers should obey some indigenous methods and IPM practices to prevent any disease establishment, in spite of using chemical control at the beginning.
- As virus disease is most devastating, so they should be careful to restrict disease spread by destroying the affected plants.
- From the study, it is recommended that the knowledge of farmer should be furnished and their perception on diseases and their management practices should be made clearer by providing training to all of the farmers.
- There should be a prescription and a rule in providing chemicals (pesticides) to the grower to restrict disease outbreak.

CHAPTER VI
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APPENDIX A

Agrotechnology Discipline

Khulna University, Khulna

"Farmer's Knowledge, Perceptions and Management Practices of Tomato Yellow Leaf Curl Virus Disease in Dumuria Upazila"

(Confidentiality will be maintained and all information will be used only for study purpose)

Respondent No. _____

Name _____ Contact no. _____

Village _____ Union _____

Upazila _____ District _____

1) Age of the respondents (Years):

2) Educational qualification:

☐ Cannot read and write ☐ _____ Class passed.

3) Family size: Please mention the number of your family members ----------

a) Male..... b) Female.....

4) Farm size: Please furnish information about your lands according to use

Sl. No.	Use of land	Area of land	
		Local unit	Hectare
A1	Homestead		
A2	Own land under own cultivation		
A3	Land taken from others on borga		
A4	Land given to others on borga		
A5	Land taken from others on lease		

A6	Land given to others on lease		
A7	Others		
Total			

Equation: FS=A1+A2+1/2(A3+A4) +A5-A6+A7

5) Area under tomato cultivation: ---------- Hectare

6) Experience in farming: ----------years.

7) Experience in tomato cultivation: ----------years.

8) Income from tomato cultivation (Tk):

9) Total Annual income:

Sl. No.	Sources of income	Amount of Taka
1	Crop farming	
2	Livestock rearing	
3	Fisheries	
4	Business	
5	Service	
6	Day labourer	
7	Others	
Total		

10) Organizational participation: Are you involved in any organization? Yes ---- No ------.
If yes, please mention the nature and duration of your participation in the following organizations.

Sl. No.	Name of organizations	Nature of participation (with duration)				
		Executive committee officer (3)	Executive committee member (2)	Ordinary member (1)	Not involved (0)	Duration (years)
1	Farmers' cooperative committee					
2	School committee					
3	Mosque/Mondir/Church/Pagoda committee					
4	Madrashah committee					
5	NGO committee					
6	Union council					
7	Youth club					
8	Cricket/Football club					
9	Others					

11) Cosmopoliteness:

Sl. No.	Place of visit	Nature of visit			
		Frequently (3)	Occasionally (2)	Rarely (1)	Not at all (0)
1	Relative or other known persons located outside of your own village	5-6 times/month	3-4 times/month	1-2 times/month	0 times/month
2	Union parishad office	8-10 times/month	5-6 times/month	2-3 times/month	0 times/month
3	Own/other Upazila sadar	5-6 times/month	3-4 times/month	1-2 times/month	0 times/month

4	Own/other district sadar	4 times/year	3 times/year	1-2 times/year	0 times/year
5	Capital and other cities	3 times/year	2 times/year	1 times/year	0 times/year

12) Training:

Have you received any training? Yes ---------- No ----------

If yes, please mention the name of the training with duration you have received from different organization

Sl. No.	Title of the training	Duration	Organization	Venue of training
1				
2				
3				
4				

13) Extension media contact:

Sl. No	Media	Extension contact				
		Never (0)	Seldom (1)	Sometimes (2)	Often (3)	Regularly (4)
I.	Peer group contact					
II.	Agricultural extension officers					
III.	NGO persons					
IV.	Input dealers(e.g. fertilizer dealers)					
V.	Neighbors/ Relatives					

VI.	Radio/TV/Leaflets/Newspaper/ Mobile phone					
VII.	Sub assistant agricultural officers					
VIII.	Field day					
IX.	agricultural poster, advertisement					

14) Knowledge about TYLCV:

Sl. No.	Questions	Full Marks	Marks Obtained
1.	Mention two major disease of tomato.	2	
2.	Name two viral disease of tomato.	2	
3.	What is the causal agent of TYLCV?	2	
4.	Name the insect vector of TYLCV.	2	
5.	What are the symptoms of TYLCV?	2	
6.	How TYLCV does disseminates?	2	
7.	Which chemical is used to control the insect vector?	2	
8.	Name two seed treating chemical.	2	
9.	What is pheromone trap?	2	
10.	Mention two resistant variety of tomato.	2	
11.	How crop rotations help you to control disease?	2	
12.	What is meant by disease management?	2	

15) Perception of TYLCV:

Statements	Degree of agreement				
	strongly agree(5)	Agree (4)	Undecided (3)	Disagree (2)	strongly Disagree(0)
a. Problem related					
1. tomatoes are more susceptible to diseases					
2. lack of quality seed					
3.solely dependent on chemical control to control white fly					
4. virus diseases are difficult to control					
5. TYLCV insect vector has a wide range of host.					
6. TYLCV is very destructive disease					
7. TYLCV spreads easily					
b. Solution related					
1. clean cultivation can control TYLCV					
2. rouging of infected plants can control TYLCV					
3.Crop rotation can help in preventing diseases					

4. Bio-pesticides are eco-friendly					
5.controlling the vector can control the disease					
6.cultivation of resistant variety restrict disease spread					
7.using of pheromone trap helps in controlling white fly(vector)					
8.cultivation on alternate time may help in controlling disease					

16) Management of TYLCV:

Sl. No.	Management practices	Degree of adoption			
		Frequently (3)	Occasionally (2)	Rarely (1)	Never (0)
	a) Pre sowing:				
1.	Soil treat				
2.	Use of healthy seeds (Free from insects and disease)				
3.	Cultivation of resistant variety				
4.	Crop rotation				
5.	Maintains cropping season				
	b) Standing crop				
1.	Weed management (Prevention, Eradication And Control)				