

SYMPTOMATOLOGY AND SEROLOGICAL SURVEY OF VIRUSES INFECTING SUGAR BEET CULTIVATION IN EGYPT

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ABSTRACT

A survey was conducted in the main Egyptian sugar beet growing areas to determine the occurrence and incidence of *Cucumber mosaic cucumovirus* (CMV), *Beet mosaic potyvirus* (BtMV), *Beet necrotic yellow vein benyvirus* (BNYVV), *Beet curly top geminivirus* (BCTV) and *Beet yellows closterovirus* (BYV) symptomatology and serologically by double antibody sandwich Enzyme linked immunosorbent assay (DAS-ELISA). The survey of sugar beet viruses achieved in 15 field locations belonging to 5 different Governorates, which performed by examination 915 plant samples from 149 fields in two seasons (2009/2010 and 2010/2011) symptomatology. During survey, 464 of naturally infected sugar beet plants showing distincted for one or more viruses were collected from 73 fields in season 2009/2010, while from 76 field, the total of examined plants were 451 through the second season (2010/2011), upon external symptoms. All samples were distributed in 8 symptomatic groups in the forms of: vein clearing, mottling, mosaic, blisters, leaf curling, stunting, yellowing and necrosis. Depending on the external symptoms, the present study revealed that, the total of expected and recorded viruses was five sugar beet viruses (CMV, BtMV, BNYVV, BCTV and BYV). The highly incidence percentage was recorded to BCTV (53.3 and 47.2 %) for both seasons (2009/2010 and 2010/2011). The values of ELISA conformation of total tested 240 of 915 samples of naturally cultivated plants were detected serologically by DAS-ELISA for CMV, BtMV and BNYVV infection were 225 samples reacted positively. The total positive samples were 112 samples for season 2009/2010 and 113 positive ones for season 2010/2011. The total positives for individual CMV infection were 45 and their highest frequency percentage was 29.79 % of the samples collected from El-Gharbia Governorate. The total positive individual BtMV and BNYVV infections were 59 (35.71 %) and 13 (11.90 %) respectively collected from El-Behiera Governorate.

Key words: *Beta vulgaris*, CMV, BtMV, BNYVV, BCTV, BYV, symptomatology, survey DAS-ELISA.

INTRODUCTION

Sugar beets (*Beta vulgaris* L.) are produced on approximately 8.1 million hectares in 41 countries around the world. Currently, sugar beets account for 25 % of the world supply of raw sugar, but the majority of production comes from sugar cane. However, sugar beet has advantages more than sugar cane such as, it is mainly the shorter duration of its growing season, the less water requirements, adaptation of the plant to the poor soil and sugar beet foliage provide rich and green animal forage in summer season Luković *et al.*, (2009).

Sugar beet is cultivated in 17 Governorates in Egypt, mostly certain

which include Kafer El-Sheikh, Dakahlia, El-Behiera, El-Gharbia, El-Menia and El-Fayoum. It's cultivated area and productivity have been doubled several folds, from 11,000 feddans in 1981 to 361,896 feddans in 2011 with average yield of 20.69 tons/feddan, (Egyptian Ministry of Agriculture and Land Reclamation, 2012). All over of the world Sugar beet was found to be naturally infected with 16 plant viruses (Mayo *et al.*, 2005) seven of them recorded in Egypt such as, *Cucumber mosaic cucumovirus* (CMV) (Megahed *et al.*, 2014), *Beet mosaic potyvirus* (BtMV) (Abdel-Ghaffar *et al.*, 2003), *Beet necrotic yellow vein benyvirus* (BNYVV)

(Abdel-Salam and El-Shazly, 2002), *Beet curly top geminivirus* (BCTV) (Abdel-Salam and Amin, 1990), *Beet yellows closterovirus* (BYV) (Abdel-Salam *et al.*, 1991), *Beet western yellows luteovirus* (BWYV) (Abdel-Salam *et al.*, 1997) and *Beet necrotic ringspot ilarvirus* (BNRSV) (Abdel-Salam *et al.*, 2005).

Choueiri *et al.*, (2001) reported that, field surveys were carried out in the main sugar beet growing areas of Lebanon in June, July and August 1999 to assess the occurrence and distribution of viral disease in the crop. A total of 1002 samples from 115 commercial fields were serologically assessed for CMV, BNYVV, BYV and *Beet western yellows luteovirus* (BWYV) by ELISA tests which revealed that, 39.5 % of samples were infected with one or more viruses and CMV was the common (56.5 %), followed by BYV (29.5 %), and BWYV (11 %). Mixed infections were detected in 5.2 % of the samples. Farzadfar *et al.*, (2007) found that, the main Iranian sugar beet growing areas were surveyed for the occurrence and incidence of BNYVV, *Beet soilborne virus* (BSBV) and *Beet virus Q* (BVQ). During the growing seasons of 2001, 2004 and 2005, root samples from 3486 plants were collected from 184 commercial sugar beet fields of 14 provinces from randomly selected and symptomatic plants and analyzed by Tissue printing immunoassay. BNYVV was prevalent (overall incidence of 52.4 %), followed by BSBV (9.8 %) and BVQ (1.4 %). High levels of virus infections more than 70 % were found in Ardabil, Esfahan, Fars, Khorasan and Zanzan provinces. Mennan *et al.*, (2012) found that, a total of 200 soil samples were collected randomly from fields in Samsun, Amasya, Tokat, Corum, and Cankr provinces, Turkey during survey which conducted in 2004 and 2005 growing seasons to determine the distribution of BNYVV, BSBV, their vector *Polymexa betae* and sugar beet cyst nematode (*Heterodera schachtii* Schm.). The results of ELISA tests showed that,

BSBV was the most prevailing virus (40.5 %), followed by BNYVV (27.5 %) in the regions. Of the 200 fields surveyed, 92 samples infested by at least one virus (46 %), 55 samples infested by sugar beet cyst nematode (27.5 %) and 161 samples infested by viruliferous or aviruliferous *P. betae* (80.5 %). In the mixed infections, the combination BNYVV and BSBV was the most frequent 15 % followed by aviruliferous *P. betae* + sugar beet cyst nematode (8.5 %). Also, the number of nematode cysts was significantly lower in BNYVV + *P. betae*, BSBV + *P. betae*, BNYVV + BSBV + *P. betae* and aviruliferous *P. betae* compared with healthy samples.

The current study aims at survey of viruses infecting sugar beet crops in Egypt depending on external symptom examination and serological confirmation.

MATERIALS AND METHODS:

Survey of sugar beet viruses:

Sugar beet fields were investigated during February and March in two seasons 2009/2010 and 2010/2011. A total number of 915 samples of sugar beet plants through two seasons were collected from 149 fields naturally infected with sugar beet viruses. These plants showing distinctive virus-like symptoms in the form of: vein clearing, mottling, mosaic, blisters, leaf curling, stunting, yellowing and necrosis on sugar beet cvs. Pleno, Gazella, Elmagari, Top, Primera, Ras poly and Glorius poly for season 2009/2010; and Gazella, Pamher, Elmagari, Kawemira, Ras poly and Desprez poly for season 2010/2011: 108 fields in North Delta (59 Kafr El-Sheikh, 28 El-Behiera and 21 fields in El-Dakahyia) and 41 fields in Middle Egypt (16 El-Gharbia and 25 field from El-Fayoum) (Table 1).

The samples were collected in plastic pages and directly transferred in ice box to Virology Laboratory, Agricultural Microbiology Department, Faculty of Agriculture, Ain Shams University, Cairo,

Egypt. The samples were classified into 8 groups depending on the previous external symptoms. The frequency incidence of different five sugar beet viruses (CMV, BtMV, BNYVV, BCTV and BYV) was calculated in all collected samples and for each symptomatic group according the external viral symptoms for each season individually.

Detection of sugar beet viruses by DAS-ELISA:

The sugar beet viruses (CMV, BtMV and BNYVV) were detected serologically by DAS-ELISA according to **Clark and Adams (1977)** in 120 naturally infected samples of each season from 5 Governorates, as 24 samples represented each Governorate (3 samples of each symptomatic group). The specific polyclonal antibodies IgG-CMV, IgG-BtMV and IgG-BNYVV of DAS-ELISA kits were kindly provided by Prof. Dr. Stephan Winter, Head of Plant Virus Dept., Leibniz-Institut Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH (DSMZ), German collection of microorganisms and cell cultures, Inhoffenstrasse 7B, 38124 Braunschweig, Germany.

RESULTS:

Survey of sugar beet viruses:

Survey of viral infection symptomatology:

Survey for sugar beet viruses was performed in two seasons (2009/2010 and 2010/2011) on naturally plantations sugar beet plants cvs. Pleno, Gazella, Elmagari, Top, Primera, Ras poly and Glorius poly for season 2009/2010, and Gazella, Pamher, Elmagari, Kawemira, Ras poly and Desprez poly for season 2010/2011 depending on the external virus-like symptoms. Data in table (1) showed, a total number of sugar beet, 915 plants through two seasons. During season (2009/2010), there are 464 investigated plants collected from total 73 fields belong to five Governorates. From the same governorates and field locations, the

total of examined plants was 451 from 76 fields through the second season (2010/2011), upon external symptoms.

The investigated plant samples were collected from 108 fields in North Delta as; 59 Kafr El-Sheikh, 28 El-Behiera and 21 El-Dakahyilia; and 41 fields in Middle Egypt including 16 from El-Gharbia and 25 fields of El-Fayoum Governorate.

The recorded data in table (1) revealed that, in Kafr El-Sheikh Governorate, the total investigated plants were 390 samples consist of 207 and 183 plants during seasons (2009/2010) and (2010/2011), respectively in three major field location; El-Reyad, Syedi Salem and Desuq. The common external symptoms localized were observed like as; mosaic, blisters, leaf curl, yellowing, necrosis and stunting recorded in El-Reyad field location; vein clearing, mottling, mosaic, blisters, leaf curl, yellowing, necrosis and stunting in Syedi Salem; and vein clearing, mottling, leaf curl, yellowing and stunting in Desuq field location.

In El-Behiera Governorate, from three field locations; El-Rahmania, El-Nubaria and El-Bustan, 121 plants were investigated during season (2009/2010) and 79 samples during season (2010/2011). The major observed external symptoms were vein clearing, mosaic, leaf curl, yellowing, necrosis and stunting in El-Rahmania; vein clearing, mottling, mosaic, leaf curl, yellowing and stunting in El-Nubaria; and mosaic, leaf curl, blisters, yellowing and stunting in El-Bustan field location.

The investigated plants in Pelqas, El-Semblaween and Talkha field locations represented in El-Dakahyilia Governorate through seasons (2009/2010) and (2010/2011), were 35 and 72 samples, respectively. The forms of localized external symptoms in Pelqas were mosaic, blisters, leaf curl, yellowing, necrosis and stunting; in El-Semblaween were mottling, mosaic, vein clearing, leaf curl, yellowing and stunting; and in Talkha

were vein clearing, mosaic, blisters, leaf curl and stunting.

In El-Gharbia Governorate from field locations Quttor, El-Mehala El-Kobra and Basiun, during two seasons (2009/2010) and (2010/2011), the obtained plants showing external symptoms were 47 and 38, recorded in at the common forms of (vein clearing, mottling, leaf curl, yellowing, necrosis and stunting); (vein clearing, mottling, mosaic, leaf curl and yellowing) and (vein clearing, mottling, leaf curl yellowing and stunting), respectively.

Three field locations Ebshway, El-Fayoum and Tamia belonging to El-Fayoum Governorate have localized with different external symptoms such as: (vein clearing, mottling, mosaic, blisters, leaf curl, yellowing, necrosis and stunting); (vein clearing, mottling, mosaic, leaf curl, yellowing, necrosis and stunting); and (vein clearing, mosaic, blisters, yellowing and necrosis), respectively. The previous symptoms, referred to the samples collection which consist of 54 and 79 samples through seasons (2009/2010) and (2010/2011), respectively (Table 1).

Table (1): Survey of naturally infected sugar beet plants showing virus-like symptoms growing under different climate conditions at two seasons (2009/2010 and 2010/2011) in Egypt.

Source of samples	Region		North Delta									Middle Egypt					Total no. of fields and samples
	Governorate	Kafr El-Sheikh			El-Behiera			El-Dakahyia			El-Gharbia		El-Fayoum				
	Field location	El-Reyad	Syedi Salem	Desuq	El-Rahmania	El-Nubaria	El-Bustan	Pelqas	El-Semblaween	Talkha	Quttor	El-Mehala El-Kobra	Basiun	Ebshway	El-Fayoum	Tamia	
Season 2009/2010	No. of fields	9	16	6	8	5	3	3	4	1	5	2	2	3	3	3	73
	No. of samples	69	100	38	41	45	35	11	20	4	26	14	7	16	21	17	464
	Symp.	M, LC, Y, S	VC, m, LC, Y, N, S	VC, m, LC, Y, S	M, LC, Y, S	VC, m, LC, S	M, LC, Y, S	M, B, LC, Y	VC, M, LC	M, B, LC, S	VC, m, LC, N, Y, S	VC, M, LC	VC, m, LC, Y, S	VC, m, M, B, LC, Y, N, S	VC, m, LC, Y, N, S	M, B, Y, N	-
Season 2010/2011	No. of fields	8	13	7	7	3	2	9	3	1	3	2	2	7	6	3	76
	No. of samples	63	74	46	30	27	22	53	13	6	11	18	9	39	25	15	451
	Symp.	M, B, LC, Y, N, S	VC, m, M, B, LC, Y, N, S	VC, m, LC, Y	VC, M, Y, N	M, LC, Y, S	M, B, LC, Y, S	M, B, LC, Y, N, S	VC, m, LC, Y, S	VC, M, LC, S	VC, m, LC, Y, N, S	VC, m, LC, Y	VC, m, LC, Y, S	VC, m, M, B, LC, Y, N, S	VC, M, LC, S	VC, M, Y	-
Total	No. of fields	59			28			21			16		25			149	
	No. of samples	390			200			107			85		133			915	

M = Mosaic; B = Blisters; m = mottling; VC = Vein Clearing; LC = Leaf Curl; N = Necrosis; S = Stunting and Y = Yellowing.

Expected sugar beet viruses depending upon external symptoms:

The external systemic symptoms were observed on naturally infected sugar beet plants during two seasons were divided to five categories of sugar beet viruses related to CMV, BtMV, BNYVV, BCTV and BYV, depending on external symptoms types (Table 2).

The first investigated category of naturally infected sugar beet plants was showed different CMV-like symptoms including vein clearing, mosaic, blisters, stunting and narrow leaf.

The second viral category included all investigated sugar beet plants exhibiting different BtMV-like symptoms during open field survey. The forms of BtMV-like symptoms have severe mosaic,

blisters, narrow leaf, stunting and leaf malformation.

The third category included several plants showing distinct virus-like symptoms specific to BNYVV. The symptoms included pale green, long petioles, upright growth, vein necrosis, stunting for vegetative growth, formation of hairy roots, necrosis and severe malformation of sugar beet roots.

In the fourth viral category of symptoms, different sugar beet plants have several external symptoms such as; vein clearing, stunting, leaf curl and leaf cup shape, these symptoms are exhibiting as BCTV-like symptoms.

The fifth category of viral symptoms was included the most sugar beet plants showing distinctive BYV-like symptoms as, green vein binding, yellowing and reduction of leaf area.

The occurrence percentage of each individual CMV, BtMV, BNYVV, BCTV and BYV were differed among field locations for all Governorates during seasons (2009/2010) and (2010/2011) in naturally open field according the viral external symptoms, table (2).

Results in table (2) presented that, at 2009/2010 season, the highly occurrence percentage was 53.3 % for BCTV in El-Behiera Governorate at El-Nubaria location, while no occurrence was recorded to BNYVV (0.0 %) at the field locations of El-Nubaria (El-Behiera Governorate); El-Semlawaen and Talkha (El-Dakahlia Governorate); and El-Mehala El-Kobra and Basiun (El-Gharbia Governorate). The highly occurrence percentage of CMV, BtMV, BNYVV, BCTV and BYV were 37.6 % at El-Reyad (Kafr El-Sheikh Governorate); 42.9 % at El-Mehala El-Kobra (El-Gharbia Governorate); 26.3 % Desuq (Kafr El-Sheikh Governorate); 53.3 % El-Nubaria (El-Behiera Governorate) and 35.2 % at Tamia (El-Fayoum Governorate), respectively.

The data of the viral occurrence percentage during season (2010/2011) in

table (2) showed that, The highly occurrence percentage of all viral infection was recorded for BCTV as 47.2 % at the investigated field location of Syedi Salem in Kafr El-Sheikh Governorate, on the other side, no occurrence was recorded to BNYVV (0.0 %) at field locations of Desuq (Kafr El-Sheikh Governorate), El-Bustan (El-Behiera Governorate), Talkha (El-Dakahlia Governorate) and El-Mehala El-Kobra (El-Gharbia Governorate). The highly occurrence percentage of CMV, BtMV, BNYVV, BCTV and BYV were 38.5, 46.7, 18.2, 47.2 and 33.3 % at El-Semlawaen (El-Dakahlia Governorate), Tamia (El-Fayoum Governorate), Quttur (El-Gharbia Governorate), Syedi Salem (Kafr El-Sheikh Governorate) and, in both locations Talkha (El-Dakahlia Governorate) and Basiun (El-Gharbia Governorate), respectively.

Sugar beet viruses serologically detected during survey:

Sugar beet viruses infected sugar beet plants in different field locations during two seasons (2009/2010) and (2010/2011) were detected and confirmed serologically using DAS-ELISA. The serologically conformation was performed to 240 naturally infected samples during two seasons using the specific polyclonal antibodies for the most distributed and economic importance of IgG-CMV, IgG-BtMV and IgG-BNYVV by DAS-ELISA kits, table (3 and 4).

The obtained ELISA conformation results of total tested 240 samples to calculate the positive individual or mixed infection with CMV, BtMV and BNYVV, revealed that, 225 samples reacted positively, while only 15 samples reacted negatively with three specific antibodies ones.

During season (2009/2010), the total positive samples for CMV, BtMV and BNYVV were 112 samples and 8 samples were gave negative reactions using specific polyclonal antibodies IgG-CMV,

IgG-BtMV and IgG- BNYVV (Table 3). The total positive samples of each Governorate were 24 samples for Kafr El-Sheikh, 21 samples of each El-Behiera and El-Dakahyilia Governorates, and 23 positive samples of both El-Gharbia and El-Fayoum Governorates.

Seven samples recorded negative reaction out of 120 samples (Table 4), the

total positive samples recorded for each Governorate were 23, 21, 24, 24 and 21 for Kafr El-Sheikh, El-Behiera, El-Dakahyilia, El-Gharbia and El-Fayoum Governorates, respectively in season (2010/2011).

Table (2): Occurrence percentage of some sugar beet viruses naturally infected sugar beet plants during two seasons (2009/2010 and 2010/2011) upon external symptoms.

Source of samples	Region		North Delta							Middle Egypt							Total	
	Governorate		Kafr El-Sheikh			El-Behiera		El-Dakahyilia		El-Gharbia			El-Fayoum					
	Field location	El-Reyad	Syedi Salem	Desuq	El-Rahmania	El-Nubaria	El-Bustan	Pelqas	El-Semlaween	Talkha	Quttor	El-Mehala El-Kobra	Basin	Ebshway	El-Fayoum	Tamia		
Season 2009/2010	*CMV	*NIS	26	21	3	6	5	10	4	7	1	8	5	2	3	1	3	105
		%	37.6	21	7.8	14.6	11.1	28.6	36.4	35.0	25.0	30.8	35.7	28.6	18.8	4.8	17.4	-
	BtMV	NIS	10	29	11	11	16	7	2	4	1	5	6	2	5	3	4	116
		%	14.4	29	28.9	26.8	35.5	20.0	18.2	20.0	25.0	19.2	42.9	28.6	31.3	14.3	23.5	-
	BNYVV	NIS	9	16	10	4	0.0	5	1	0.0	0.0	4	0.0	0.0	3	5	3	60
		%	13.0	16	26.3	9.8	0.0	14.3	9.1	0.0	0.0	15.4	0.0	0.0	18.8	23.8	17.6	-
	BCTV	NIS	14	25	9	17	24	8	3	9	2	7	3	2	4	8	1	136
		%	20.2	25	23.6	41.5	53.3	22.9	27.3	45.0	50.0	26.9	21.4	28.6	25.0	38.1	5.8	-
	BYV	NIS	10	9	5	3	0.0	5	1	0.0	0.0	2	0.0	1	1	4	6	47
		%	14.4	9	13.1	7.3	0.0	14.3	9.1	0.0	0.0	7.7	0.0	14.3	6.3	19.04	35.2	-
	***TES		69	100	38	41	45	35	11	20	4	26	14	7	16	21	17	464
	Season 2010/2011	CMV	**NIS	13	16	14	9	8	7	12	5	1	2	6	2	7	7	5
%			20.6	21.6	30.4	30.0	29.6	31.8	22.6	38.5	16.7	18.2	33.3	22.2	17.9	28.0	33.3	-
BtMV		NIS	17	8	10	11	3	5	15	2	1	2	2	1	10	4	7	98
		%	26.9	10.8	21.7	36.7	11.1	22.7	28.3	15.4	16.6	18.2	11.1	11.1	25.6	16.0	46.7	-
BNYVV		NIS	3	6	0.0	3	1	0.0	6	1	0.0	2	0.0	1	7	3	1	34
		%	4.8	8.1	0.0	10.0	3.7	0.0	11.3	7.7	0.0	18.2	0.0	11.1	17.9	12.0	6.7	-
BCTV		NIS	22	35	12	2	7	9	15	4	2	3	8	2	12	11	0.0	144
		%	34.9	47.2	26.1	6.6	25.9	40.9	28.3	30.8	33.3	27.3	44.4	22.2	30.8	44.0	0.0	-
BYV		NIS	8	9	10	5	8	1	5	1	2	2	2	3	3	0.0	2	61
		%	12.7	12.1	21.7	16.6	29.6	4.5	9.4	7.7	33.3	18.2	11.1	33.3	7.7	0.0	13.3	-
TES			63	74	46	30	27	22	53	13	6	11	18	9	39	25	15	451

* All viruses named based on the distinctive of permanent development external symptoms
 ** NIS = Number of infected samples
 *** TES = Total of examined samples (Table 1)
 **** Total = Total of collected samples (Table 1).

SYMPTOMATOLOGY AND SEROLOGICAL SURVEY OF VIRUSES INFECTING SUGAR BEET
CULTIVATION IN EGYPT

Table (3): ELISA conformation of CMV, BtMV and BNYVV occurrence in naturally infected sugar beet plants showing distinctive virus symptoms collected from different regions in season (2009/2010).

Source of samples	Region	North Delta									Middle Egypt						
	Governorate	Kafr-El-Sheikh			El-Behiera			El-Dakahyia			El-Gharbia			El-Fayoum			
	*TIS	CMV	BtMV	BNYVV	CMV	BtMV	BNYVV	CMV	BtMV	BNYVV	CMV	BtMV	BNYVV	CMV	BtMV	BNYVV	
Season 2009/2010	120 investigated samples	ve	+ve	ve	ve	+ve	ve	+ve	ve	ve	+ve	+ve	ve	+ve	+ve	+ve	
		0.165	0.438	0.200	0.190	0.444	0.183	0.380	0.158	0.148	0.390	0.438	0.165	0.368	0.370	0.465	
		+ve	+ve	+ve	+ve	+ve	ve	+ve	+ve	ve	ve	+ve	+ve	ve	ve	ve	ve
		0.461	0.336	0.419	0.406	0.379	0.179	0.396	0.388	0.166	0.155	0.615	0.150	0.165	0.185	0.190	
		+ve	ve	ve	+ve	+ve	ve	ve	+ve	ve	+ve	+ve	+ve	+ve	+ve	+ve	ve
		0.383	0.168	0.214	0.488	0.357	0.152	0.156	0.401	0.160	0.353	0.375	0.466	0.395	0.353	0.154	
		+ve	+ve	ve	ve	ve	+ve	+ve	+ve	ve	+ve	ve	ve	+ve	+ve	+ve	+ve
		0.581	0.419	0.180	0.180	0.155	0.423	0.421	0.367	0.157	0.366	0.148	0.148	0.388	0.388	0.377	
		ve	ve	+ve	ve	ve	ve	ve	+ve	+ve	+ve	ve	ve	ve	ve	+ve	ve
		0.148	0.172	0.538	0.195	0.163	0.150	0.200	0.388	0.511	0.401	0.155	0.150	0.160	0.397	0.181	
		ve	+ve	ve	ve	+ve	ve	+ve	ve	ve	+ve	ve	+ve	+ve	+ve	ve	ve
		0.177	0.420	0.167	0.164	0.438	0.211	0.500	0.144	0.182	0.388	0.155	0.395	0.377	0.163	0.150	
		+ve	ve	ve	+ve	ve	ve	+ve	+ve	ve	ve	+ve	+ve	ve	+ve	+ve	+ve
		0.395	0.189	0.183	0.375	0.222	0.192	0.388	0.392	0.159	0.156	0.368	0.420	0.183	0.402	0.410	
		ve	+ve	ve	ve	ve	+ve	+ve	+ve	ve	+ve	+ve	ve	ve	ve	+ve	+ve
		0.184	0.350	0.169	0.201	0.185	0.399	0.410	0.553	0.188	0.377	0.385	0.161	0.177	0.385	0.395	
		ve	+ve	ve	+ve	ve	ve	ve	ve	ve	ve	+ve	ve	ve	+ve	+ve	ve
		0.196	0.605	0.180	0.453	0.177	0.160	0.164	0.163	0.173	0.170	0.373	0.188	0.385	0.377	0.168	
		+ve	+ve	ve	ve	+ve	ve	ve	ve	ve	+ve	+ve	ve	ve	ve	+ve	ve
		0.457	0.479	0.203	0.172	0.601	0.221	0.204	0.181	0.145	0.396	0.400	0.155	0.145	0.422	0.150	
+ve	+ve	ve	ve	+ve	ve	+ve	ve	ve	+ve	ve	ve	ve	ve	+ve	+ve		
0.400	0.438	0.214	0.155	0.553	0.175	0.366	0.194	0.211	0.432	0.152	0.180	0.160	0.155	0.380			
ve	ve	+ve	ve	ve	ve	ve	+ve	+ve	+ve	ve	ve	ve	ve	+ve	ve		
0.118	0.188	0.538	0.190	0.155	0.159	0.182	0.388	0.356	0.396	0.180	0.150	0.200	0.380	0.175			
ve	+ve	ve	ve	+ve	ve	+ve	ve	ve	+ve	ve	+ve	+ve	+ve	ve	ve		
0.197	0.424	0.152	0.194	0.368	0.181	0.511	0.210	0.172	0.365	0.153	0.342	0.390	0.163	0.158			
+ve	ve	ve	+ve	ve	ve	+ve	+ve	ve	ve	+ve	+ve	ve	+ve	+ve	+ve		
0.359	0.149	0.180	0.355	0.199	0.203	0.365	0.352	0.199	0.166	0.395	0.400	0.139	0.436	0.395			
ve	+ve	ve	ve	ve	+ve	+ve	+ve	ve	+ve	+ve	ve	ve	+ve	+ve	+ve		
0.200	0.327	0.172	0.188	0.185	0.379	0.510	0.450	0.172	0.380	0.385	0.188	0.175	0.350	0.388			
ve	+ve	ve	+ve	ve	ve	ve	ve	ve	ve	+ve	ve	+ve	+ve	ve	ve		
0.156	0.477	0.205	0.412	0.222	0.146	0.177	0.160	0.177	0.150	0.351	0.189	0.366	0.370	0.165			
+ve	+ve	ve	ve	+ve	ve	ve	ve	ve	+ve	+ve	ve	ve	+ve	+ve	ve		
0.355	0.408	0.180	0.164	0.410	0.174	0.174	0.170	0.195	0.425	0.367	0.165	0.175	0.434	0.158			
+ve	+ve	ve	ve	+ve	ve	+ve	ve	ve	+ve	ve	ve	ve	ve	+ve	+ve		
0.412	0.433	0.200	0.155	0.545	0.211	0.324	0.194	0.200	0.430	0.179	0.174	0.170	0.167	0.375			
ve	ve	+ve	+ve	+ve	+ve	+ve	+ve	ve	+ve	+ve	ve	ve	+ve	+ve	ve		
0.194	0.185	0.416	0.380	0.370	0.410	0.348	0.402	0.161	0.480	0.400	0.161	0.175	0.384	0.181			
+ve	ve	ve	ve	+ve	ve	+ve	ve	ve	+ve	+ve	+ve	ve	+ve	ve	ve		
0.366	0.164	0.190	0.145	0.384	0.184	0.433	0.150	0.180	0.355	0.380	0.411	0.145	0.401	0.185			
+ve	+ve	ve	+ve	ve	ve	ve	+ve	ve	ve	ve	ve	+ve	+ve	+ve	+ve		
0.431	0.374	0.200	0.400	0.194	0.168	0.180	0.362	0.165	0.167	0.200	0.157	0.400	0.365	0.445			
+ve	ve	ve	ve	ve	ve	+ve	+ve	ve	+ve	ve	ve	ve	+ve	ve	ve		
0.380	0.206	0.185	0.179	0.150	0.195	0.350	0.422	0.175	0.388	0.174	0.220	0.153	0.378	0.165			
ve	+ve	+ve	+ve	ve	ve	+ve	ve	ve	+ve	ve	ve	ve	+ve	+ve	+ve		
0.182	0.387	0.396	0.438	0.168	0.147	0.399	0.179	0.152	0.444	0.155	0.200	0.196	0.392	0.375			

*TIS = 120 Total investigated samples collected as 24 samples from each Governorate in one season depending on external symptoms.

Reading greater than twice the A_{405} value of healthy controls was considered positive:

ve = negative +ve = positive.

Table (4): ELISA conformation of CMV, BtMV and BNYVV occurrence in naturally infected sugar beet plants showing distinctive virus symptoms collected from different regions in season (2010/2011).

Source of samples	Region	North Delta									Middle Egypt					
	Governorate	Kafr El-Sheikh			El-Behiera			El-Dakahyia			El-Gharbia			El-Fayoum		
	[*] TIS	CMV	BtMV	BNYVV												
Season 2010/2011 120 investigated samples		+ve 0.385	+ve 0.402	+ve 0.522	+ve 0.375	+ve 0.348	+ve 0.450	^{ve} 0.183	+ve 0.368	+ve 0.399	+ve 0.400	^{ve} 0.190	^{ve} 0.190	+ve 0.395	+ve 0.388	+ve 0.375
		+ve 0.377	+ve 0.400	^{ve} 0.155	^{ve} 0.196	+ve 0.370	^{ve} 0.160	+ve 0.380	+ve 0.390	^{ve} 0.145	+ve 0.385	^{ve} 0.181	+ve 0.386	+ve 0.370	+ve 0.382	^{ve} 0.140
		+ve 0.423	^{ve} 0.140	+ve 0.395	^{ve} 0.160	+ve 0.360	^{ve} 0.150	^{ve} 0.160	+ve 0.377	^{ve} 0.183	+ve 0.382	^{ve} 0.182	^{ve} 0.176	^{ve} 0.400	+ve 0.155	^{ve} 0.140
		^{ve} 0.155	+ve 0.365	^{ve} 0.162	+ve 0.359	+ve 0.393	^{ve} 0.185	+ve 0.386	^{ve} 0.188	^{ve} 0.167	+ve 0.390	+ve 0.388	^{ve} 0.374	+ve 0.140	+ve 0.375	+ve 0.385
		^{ve} 0.168	+ve 0.388	^{ve} 0.170	+ve 0.388	^{ve} 0.155	+ve 0.385	+ve 0.377	+ve 0.388	^{ve} 0.189	^{ve} 0.165	+ve 0.356	^{ve} 0.185	^{ve} 0.152	+ve 0.396	+ve 0.368
		+ve 0.400	+ve 0.390	+ve 0.387	^{ve} 0.158	^{ve} 0.140	+ve 0.385	+ve 0.384	+ve 0.400	^{ve} 0.200	+ve 0.388	+ve 0.370	^{ve} 0.169	^{ve} 0.165	+ve 0.395	^{ve} 0.153
		+ve 0.392	+ve 0.511	^{ve} 0.166	+ve 0.375	+ve 0.401	^{ve} 0.183	^{ve} 0.175	+ve 0.375	^{ve} 0.164	+ve 0.364	^{ve} 0.182	^{ve} 0.167	+ve 0.386	+ve 0.378	+ve 0.377
		^{ve} 0.190	+ve 0.399	^{ve} 0.185	^{ve} 0.138	^{ve} 0.395	^{ve} 0.190	+ve 0.390	^{ve} 0.192	^{ve} 0.196	+ve 0.188	+ve 0.390	^{ve} 0.165	^{ve} 0.157	+ve 0.385	^{ve} 0.196
		+ve 0.375	^{ve} 0.170	+ve 0.377	^{ve} 0.195	+ve 0.376	^{ve} 0.177	+ve 0.410	+ve 0.388	^{ve} 0.177	+ve 0.187	+ve 0.388	^{ve} 0.168	^{ve} 0.180	^{ve} 0.162	^{ve} 0.195
		+ve 0.364	^{ve} 0.156	^{ve} 0.140	^{ve} 0.174	^{ve} 0.200	^{ve} 0.150	^{ve} 0.155	+ve 0.390	^{ve} 0.180	+ve 0.401	+ve 0.369	+ve 0.396	^{ve} 0.183	^{ve} 0.160	+ve 0.386
		+ve 0.388	+ve 0.380	^{ve} 0.188	+ve 0.390	+ve 0.385	^{ve} 0.150	+ve 0.390	^{ve} 0.194	+ve 0.386	+ve 0.395	+ve 0.383	^{ve} 0.180	+ve 0.388	+ve 0.400	+ve 0.400
		+ve 0.410	+ve 0.366	+ve 0.411	+ve 0.370	^{ve} 0.155	^{ve} 0.165	+ve 0.386	+ve 0.380	^{ve} 0.180	+ve 0.366	^{ve} 0.180	^{ve} 0.169	+ve 0.365	+ve 0.396	+ve 0.410
		^{ve} 0.155	+ve 0.355	^{ve} 0.158	^{ve} 0.352	^{ve} 0.155	+ve 0.359	+ve 0.411	+ve 0.375	^{ve} 0.180	+ve 0.165	+ve 0.440	^{ve} 0.156	^{ve} 0.152	+ve 0.355	+ve 0.368
		+ve 0.380	+ve 0.383	+ve 0.356	^{ve} 0.196	^{ve} 0.148	+ve 0.355	+ve 0.355	+ve 0.400	^{ve} 0.185	+ve 0.359	+ve 0.368	^{ve} 0.164	^{ve} 0.155	+ve 0.352	^{ve} 0.155
		+ve 0.32	+ve 0.457	^{ve} 0.166	+ve 0.373	+ve 0.422	^{ve} 0.190	^{ve} 0.175	+ve 0.388	^{ve} 0.188	+ve 0.360	^{ve} 0.182	^{ve} 0.167	+ve 0.360	+ve 0.376	+ve 0.380
		^{ve} 0.157	+ve 0.399	^{ve} 0.170	^{ve} 0.158	+ve 0.346	^{ve} 0.193	+ve 0.364	^{ve} 0.172	^{ve} 0.196	^{ve} 0.150	+ve 0.395	^{ve} 0.165	^{ve} 0.155	+ve 0.395	^{ve} 0.190
		+ve 0.365	^{ve} 0.170	+ve 0.345	^{ve} 0.194	+ve 0.352	^{ve} 0.197	+ve 0.407	+ve 0.356	^{ve} 0.162	+ve 0.158	+ve 0.390	^{ve} 0.170	^{ve} 0.158	^{ve} 0.165	^{ve} 0.195
		+ve 0.371	^{ve} 0.177	^{ve} 0.166	^{ve} 0.180	^{ve} 0.200	^{ve} 0.188	+ve 0.165	+ve 0.390	^{ve} 0.168	+ve 0.400	+ve 0.375	+ve 0.384	^{ve} 0.172	^{ve} 0.160	+ve 0.357
		+ve 0.378	+ve 0.365	^{ve} 0.156	+ve 0.405	+ve 0.377	^{ve} 0.185	+ve 0.368	+ve 0.200	+ve 0.358	+ve 0.392	+ve 0.380	^{ve} 0.175	+ve 0.365	+ve 0.450	+ve 0.402
		+ve 0.400	+ve 0.369	+ve 0.432	+ve 0.387	^{ve} 0.160	^{ve} 0.160	+ve 0.377	+ve 0.368	^{ve} 0.150	+ve 0.370	^{ve} 0.155	^{ve} 0.168	+ve 0.388	+ve 0.415	+ve 0.408
		^{ve} 0.185	+ve 0.383	+ve 0.395	^{ve} 0.150	+ve 0.385	^{ve} 0.170	+ve 0.385	+ve 0.186	^{ve} 0.172	+ve 0.370	+ve 0.190	^{ve} 0.192	^{ve} 0.377	+ve 0.388	+ve 0.402
		+ve 0.145	+ve 0.190	+ve 0.383	^{ve} 0.170	+ve 0.155	^{ve} 0.175	+ve 0.400	+ve 0.377	^{ve} 0.188	+ve 0.380	+ve 0.375	+ve 0.382	^{ve} 0.170	+ve 0.368	^{ve} 0.170
		^{ve} 0.150	^{ve} 0.185	^{ve} 0.175	+ve 0.365	+ve 0.365	^{ve} 0.178	+ve 0.388	+ve 0.365	^{ve} 0.191	^{ve} 0.177	+ve 0.365	^{ve} 0.194	^{ve} 0.155	+ve 0.373	^{ve} 0.185
		+ve 0.355	^{ve} 0.190	+ve 0.375	+ve 0.383	^{ve} 0.180	^{ve} 0.157	+ve 0.380	^{ve} 0.195	^{ve} 0.186	+ve 0.386	+ve 0.380	^{ve} 0.186	+ve 0.358	+ve 0.365	+ve 0.394

*TIS = 120 Total investigated samples collected as 24 samples from each Governorate in one season depending on external symptoms.

Reading greater than twice the A₄₀₅ value of healthy controls was considered positive: ^{ve} = negative ⁺ = positive.

Frequency incidence of sugar beet viruses:

Data in table (5) showed that, the total number of samples reacted positively in a single and mixed infections of the tested samples during season (2009/2010) depending upon ELISA conformation results were 27 for CMV, 29 for BtMV and 9 for BNYVV single infections. When, the total positive samples in

duplicated mixed infection were 27, 2 and 10 positive samples to CMV + BtMV, CMV + BNYVV and BtMV + BNYVV, respectively. While, there are 8 samples gave positive reactions with CMV + BtMV + BNYVV viruses in mixed infection with three viruses.

The highly percentage of frequency for single positive reaction of IgG-CMV were 33.33 % of the tested samples collected

from El-Dakahyia Governorate, while the highly frequency percentages for individually positive reactions for BtMV and BNYVV were found 38.10 and 16.66 % in the investigated samples from El-Behiera and Kafr El-Sheikh, respectively. In duplicated mixed infection, the highly percentages of frequency for (CMV + BtMV) was 42.85 % from El-Dakahyia Governorate, for the mixed infection of (CMV + BNYVV) was 8.70 % from El-Gharbia Governorate and for (BtMV + BNYVV) was 21.74 % from El-Fayoum Governorate .

The highly frequency percentage of the mixed infection with three viruses (CMV + BtMV + BNYVV) was 13.04 % for the

tested samples from El-Fayoum Governorate.

The frequency incidence of sugar beet viruses individually and mixed infectious in open fields in season (2010/2011) depending upon ELISA detection, table (5), revealed that, the total of positive individual infection were 18, 30 and 4 positive samples for CMV, BtMV and BNYVV, respectively. While, in duplicated mixed infection the total positive samples were 28 positive samples to (CMV + BtMV), 9 of positive samples to (CMV + BNYVV) and 5 of positive samples to (BtMV + BNYVV). While, the total positive reactions for the mixed infection with CMV + BtMV + BNYVV was 19 samples.

Table (5): Frequency incidence of sugar beet viruses individually and mixed infectious in open fields in two seasons (2009/2010 and 2010/2011) upon ELISA detection.

Source of samples	Region		North Delta				Middle Egypt				Total positive samples	
	Governorate	Kafr El-Sheikh	EL-Behiera	EL-Dakahyia	EL-Gharbia	EL-Fayoum						
	Sugar beet viruses	*FPS	**% of frequency	FPS	% of frequency	FPS	% of frequency	FPS	% of frequency	FPS		% of frequency
Season 2009/2010	CMV	5	20.8	6	28.57	7	33.33	7	30.43	2	8.70	27
	BtMV	7	29.2	8	38.10	3	14.30	3	13.04	8	34.78	29
	BNYVV	4	16.66	3	14.29	0.0	0.0	0.0	0.0	2	8.70	9
	CMV + BtMV	6	25.0	2	9.52	9	42.85	7	30.43	3	13.04	27
	CMV + BNYVV	0.0	0.0	0.0	0.0	0.0	0.0	2	8.70	0.0	0.0	2
	BtMV + BNYVV	1	4.17	0.0	0.0	2	9.52	2	8.70	5	21.74	10
	CMV + BtMV + BNYVV	1	4.17	2	9.52	0.0	0.0	2	8.70	3	13.04	8
	Total positive samples	24	100	21	100	21	100	23	100	23	100	112
	Season 2010/2011	CMV	2	8.69	3	14.30	5	20.83	7	29.17	1	4.76
BtMV		5	21.74	7	33.33	5	20.83	7	29.17	6	28.57	30
BNYVV		1	4.35	2	9.52	0.0	0.0	0.0	0.0	1	4.76	4
CMV + BtMV		5	21.74	6	28.57	11	45.83	5	20.83	1	4.76	28
CMV + BNYVV		4	17.39	2	9.52	2	8.33	1	4.17	0.0	0.0	9
BtMV + BNYVV		1	4.35	0.0	0.0	1	4.20	0.0	0.0	3	14.30	5
CMV + BtMV + BNYVV		5	21.74	1	4.76	0.0	0.0	4	16.66	9	42.85	19
Total positive samples		23	100	21	100	24	100	24	100	21	100	113

* FPS = Frequency of positive samples (Table 3 and 4)

** % of frequency = Frequency of positive samples/Total frequency of positive sugar beet samples.

The high percentage of frequency gave single positive reaction with CMV, BtMV and BNYVV were 29.17 % for El-Gharbia Governorate, 33.33 % for El-Behiera Governorate and 9.52 % for El-Behiera Governorate, respectively. In duplicated mixed infection, the highly frequency percentages were 45.83 % from El-Dakahyia Governorate for (CMV + BtMV), 17.39 % from Kafr El-Sheikh Governorate for (CMV + BNYVV) and 4.35 % from Kafr El-Sheikh Governorate for (BtMV + BNYVV). While, in the three mixed infection (CMV + BtMV + BNYVV) the highly frequency percentage was 42.85 % from El-Fayoum Governorate.

Total frequency incidence of sugar beet viruses individually and mixed infectious in open fields during two seasons (2009/2010 and 2010/2011) upon ELISA detection and survey location was recorded in table (6).

The data presented in table (6) illustrated that, the total positive for individual CMV infection was 45 and their highest

frequency percentage was 29.79 % from El-Gharbia Governorate. While, the total positive individual BtMV and BNYVV infection were 59 and 13 positive samples and their highest frequency percentage were 35.71 and 11.90 %, respectively from El-Behiera Governorate .

The highly total of frequency percentage for duplicated mixed viral infections for (CMV + BtMV) were 44.44 % from El-Dakahyia Governorate and the total positive samples for this mixed was 55 samples. For (CMV + BNYVV), the high percentage of total frequency was 8.51 % from Kafr El-Sheikh Governorate and their total positive samples was 11 samples. While, the highest total frequency of mixed (BtMV + BNYVV) was 18.18 % from El-Fayoum Governorate and the recorded total positive samples was 15. On other mixed infection type, the total positive samples was 27 samples for CMV + BtMV + BNYVV, it's highly frequency percentage was recorded from El-Fayoum Governorate (27.27 %).

Table (6): Total frequency incidence of sugar beet viruses individually and mixed infectious in open fields during two seasons (2009/2010 and 2010/2011) upon ELISA detection and survey locations.

Source of samples	Region		North Delta				Middle Egypt				Total positive samples
	Governorate	Kafr El-Sheikh	El-Behiera	El-Dakahyia	El-Gharbia	El-Fayoum	FPS	% of frequency	FPS	% of frequency	
Sugar beet viruses	FPS	**% of frequency	FPS	% of frequency	FPS	% of frequency	FPS	% of frequency	FPS	% of frequency	
CMV	7	14.89	9	21.43	12	26.67	14	29.79	3	6.82	45
BtMV	12	25.53	15	35.71	8	17.78	10	21.28	14	31.82	59
BNYVV	5	10.64	5	11.90	0.0	0.0	0.0	0.0	3	6.82	13
CMV + BtMV	11	23.40	8	19.06	20	44.44	12	25.53	4	9.09	55
CMV + BNYVV	4	8.51	2	4.76	2	4.44	3	6.38	0.0	0.0	11
BtMV + BNYVV	2	4.26	0.0	0.0	3	6.67	2	4.26	8	18.18	15
CMV + BtMV + BNYVV	6	12.77	3	7.14	0.0	0.0	6	12.765	12	27.27	27
Total	47	100	42	100	45	100	47	100	44	100	225

* FPS = Frequency of positive samples

** % of frequency = Frequency of positive samples/Total frequency of positive sugar beet samples.

DISCUSSION

Survey for sugar beet viruses was carried out in two seasons (2009/2010 and 2010/2011) on naturally infected sugar beet plants cvs. Pleno, Gazella, Elmagari, Top, Primera, Ras poly and Glorius poly for season 2009/2010, and Gazella, Pamher, Elmagari, Kawemira, Ras poly and Desprez poly for season 2010/2011, showing different virus-like symptoms in the forms vein clearing, mottling, mosaic, blisters, leaf curling, stunting, yellowing and necrosis. Results of the present investigation showed that, the total number of viruses observed and recorded were five sugar beet viral categories (CMV, BtMV, BNYVV, BCTV and BYV) depending on external symptoms related to individual virus.

The obtained results for the occurrence percentage of each one of CMV, BtMV, BNYVV, BCTV and BYV during first season (2009/2010) illustrated that, the highly occurrence percentage was found to BCTV (53.3 %) in El-Behiera Governorate at the field location of El-Nubaria, considerable no observed symptoms related to BNYVV at the field locations of El-Nubaria (El-Behiera Governorate); El-Semblaween and Talkha (El-Dakahyia Governorate); and El-Mehala El-Kobra and Basiun (El-Gharbia Governorate). On the other hand, during season (2010/2011), the highly occurrence percentage of all viral infection was 47.2 % for BCTV at the field location of Syedi Salem in Kafr El-Sheikh Governorate, while BNYVV not recorded at the field locations (Desuq in Kafr El-Sheikh Governorate, El-Bustan in El-Behiera Governorate, Talkha in El-Dakahyia Governorate and El-Mehala El-Kobra in El-Gharbia Governorate). On the other results obtained by Abo El-Nasr (2008), the highest of whole symptomatic plants was observed in Kafr El-Sheikh

Governorate during January of both seasons (2005/2006 and 2006/2007) as 15.7 and 10.1 %, respectively. Also, the data of average number of plant showing mosaic, yellows and other in Kafr El-Sheikh Governorate were differed compared with those calculated in El-Fayoum Governorate which showed 5.8, 2.4 and 0.8 %, respectively.

Similar results were reported by Sayed et al., (2008) who found that, the samples collected from sugar beet plants exhibited virus-like symptoms from different open fields, El-Reyad district, Kafr El-Sheikh Governorate, appear to be suggested having three viruses, i.e., BtMV, BNYVV and BCTV but the symptoms concerning BtMV was observed to be dominant. Abdel-Salam and El-Shazly (2002) and Iskander et al., (2014) were confirmed the presence of BNYVV of sugar beet for the first time in Egypt in some cultivations of sugar beet in El-Fayoum and Giza Governorates. Also many investigator reported the presence for CMV (Omar et al., 1994 and Megahed et al., 2014), BtMV (Abdel-Ghaffar et al., 2003 and Omar et al., 2006), BCTV (Abdel-Salam and Amin, 1990, and Mahmoud et al., 2005) and BYV (Abdel-Salam et al., 1991), in different locations for sugar beet cultivations.

Results of the present investigation revealed that, the values of ELISA conformation of total tested 240 samples were 225 samples reacted positively, while only 15 samples reacted negatively in the individual or mixed infection with CMV, BtMV and BNYVV, against their specific polyclonal antibodies. The results were in accordance with that obtained by Omar et al., (1994), Sukhacheva et al., (1996), Owolabi et al., (1998), Chod and Chodova (2004), Abdelkader et al., (2006) and Sayed et al., (2008).

In other study by Kutluk Yilmaz (2010) ELISA absorbance value in mixed infection for BSBV was significantly reduced in the rhizomania partially resistant variety in which BNYVV level was low. In this case, the ELISA values for BNYVV were not significantly changed either single or mixed infections. In the susceptible cultivar to rhizomania, the BNYVV ELISA absorbance value was lower in mixed infection compared with BNYVV alone. However, the titer of BSBV in the susceptible plants was not significantly changed in mixed infection compared with BSBV alone.

It concluded that, during two seasons (2009/2010 and 2010/2011) the total positive for individual CMV infection was 45 which have the highest frequency percentage (29.79 %) of samples collected from El-Gharbia Governorate. The total positive individual BtMV and BNYVV infections were 59 and 13 positive samples with the highest frequency percentage 35.71 and 11.90 %, respectively related to the collected samples from El-Behiera Governorate .

The highly total of frequency percentage for duplicated mixed viral infections for (CMV + BtMV) were 44.44 % from El-Dakahyia Governorate of the total 55 positive samples. In the case of (CMV + BNYVV), the high percentage was 8.51 % of the total 11 positive samples collected from Kafr El-Sheikh Governorate. While, the total of highly frequency of mixed (BtMV + BNYVV) was 18.18 % from El-Fayoum Governorate for the total positive samples 15. The other mixed infection type, there are 27 the positive samples for CMV + BtMV + BNYVV with highly total frequency percentage 27.27 % collected from El-Fayoum Governorate.

Finally, the necessity of actual cooperation with companies of sugar

productions from sugar beet cultivations in Egypt for periodical survey and detection of sugar beet viruses to increase its production is our recommendation.

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