INVESTIGATIONS OF SPATIAL ASSOCIATION AND DITRIBUTION OF *BEET NECROTIC YELLOW VEIN VIRUS* AND *BEET SOILBORNE MOSAIC VIRUS* IN SUGAR BEET FIELDS

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ABSTRACT

Beet necrotic yellow vein virus (BNYVV) and beet soilborne mosaic virus (BSBMV) are widely distributed in sugar beet growing regions of the United States. Both viruses are vectored by *Polymyxa betae* Keskin. They are also closely related in many other biological characteristics. In some instances, both can be detected in the same sugar beet plants. However, the extent of their association and distribution in sugar beet fields is not known. In 1999 and 2000, gird soil samples were collected from sugar beet fields in Colorado, Minnesota, North Dakota, and Texas. The viruses were baited by planting sugar beets in the soil in the green house and their their incidences was were determined using DAS-ELISA. The incidence of their association in samples from various fields ranged between 1 and 42%. Except in samples from 2 fields, which exhibited some degree of clustering, the spatial patterns of the viruses were near random. Overall, both viruses exhibitedmore or less similar spatial patterns

INTRODUCTION

Beet necrotic yellow vein virus (BNYVV) and *Beet soilborne mosaic virus* are widely distributed in sugar beet growing regions of the United States (Rush and Heidel, 1995). The two viruses differ primarily in serology and symptom expression on various host plants including sugar beets (Wisler et al., 1994). BNYVV causes rhizomania of sugar beet, which is characterized by stunting, leaf necrosis and extensive root proliferation (Rush and Heidel, 1995). BSBMV causes similar symptoms but the symptoms are typically less severe than those caused by BNYVV. BSBMV, reported only from the United States, induces more systemic, mosaic-type symptoms than the leaf necrosis associated with BNYVV. However, the viruses have many biological characteristics in common including transmission by *Polymyxa betae* (Liu and Duffus, 1988). A previous study in Texas showed that both viruses can be detected in the same field (Heidel and Rush 1994). In addition, when sugar beets were grown in bulked rhizosphere soil, both viruses were able to infect the same sugar beet root. However, their relative frequencies and spatial association and distributions in sugar beet fields are not known. Such information may give some insight into their potential interaction and may also serve as a guideline for devising sampling strategies.

The primary objectives of the project were to determine the relative frequencies of the viruses and their spatial association and distribution in sugar beet fields.

MATERIALS AND METHODS

Soil samples from sugar beet fields in Colorado, Minnesota, and Texas were collected from one-acre grids (0.4 ha) across the entire field (large quadrats). In addition, in each field, one of the one-acre grids was arbitrarily selected and further grided into 3.4m x 7.6m (small quadrats) and a soil sample was collected from each grid. In the summer of 2000, additional soil samples were collected from North Dakota and Minnesota in a similar manner, with additional smaller grid sizes of 2.9m 2.9m. Soil samples were collected from 11 fields over the 2-year period. Viruses were bioassayed by planting sugar beets in soil in the greenhouse. Sugar beet roots then were tested for presence or absence of each virus by DAS-ELISA. Data were subjected to frequency and geostatistical analyses to determine their relative incidence and spatial association and distribution

RESULTS

BNYVV and BSBMV were detected in all fields (both in large and small quadrats) in greater than 49% of the samples. In both years the viruses were detected in greater frequencies singly than in association (Table 1). The frequencies of samples in which both viruses were detected varied among fields ranging from 1 to 28% in 1999 and 1 to 42% in 2000. Samples from small quadrats in Colorado exhibited cyclical patterns of spatial continuity and discontinuity for both viruses (Fig.1A and 1B). This suggests the existence of alternating random and non-random pattern within a small area but may be of no practical significance. Samples collected from the field in Minnesota in 1999 showed spatial dependency (clustering) for BNYVV within a range of 29.6 m (Spherical model, R^2 = 0.97, Fig. 1B), and for BSBMV within a range of 13.8m (exponential model, R^2 = 0.86, Fig. 1C). This is characterized by increase in semivariance in relation to an increase in separation distance. Beyond these ranges, the semivrariance remained constant at all levels of separation distance, which is characteristic of randomness (Davis, 1986). Samples collected from small quadrats in Texas (Fig. 2A) and large quadrates in all fields exhibited near randomness (constant semivariance at all separation distances; eg, Fig. 2B for BNYVV from a field in Minnesota). Overall, the spatial distribution of the viruses varied among fields. However, only two of the fields sampled at small grids (2.9m x 2.9m and 3.4 x 7.6m) exhibited meaningful spatial continuity. This may indicate that, for all practical purposes, the viruses are randomly distributed. Repeated tillage operations may have distributed the viruses in the field resulting in random spatial pattern. However, it is still possible that spatial patterns of the viruses in these fields may not have turned out to be random if they were further sampled at smaller distances than the smallest grids used in this study. Both viruses showed more or less similar spatial patterns in each field. Further description of the spatial distributions of the viruses is presented elsewhere (Workneh et al., 2003).

Table 1. Frequencies of *Beet necrotic yellow vein virus* (BNYVV) and *Beet soilborne mosaic virus* (BSBMV) in samples collected from large and small quadrats in fields in Colorado, Minnesota, North Dakota, and Texas in 1999

		Virus incidence (%)			
Field location and quadrat size	No. of samples	None	BNYVV	BSBMV	Both
Colorado					
Small	70	20.0	8.6	51.4	20.0
Large	59	50.9	15.3	28.8	5.1
Minnesota					
Small	118	43.9	21.2	17.8	17.8
Large	79	17.8	48.1	6.3	27.9
N. Dakota					
Large	74	48.7	50.1	0.0	1.4
Texas					
Small	96	50.1	0.0	49.0	1.0
Large	44	31.9	0.0	61.4	6.8

*Fig. 1. Semivariograms of spatial patterns of Beet necrotic yellow vein virus (BNYVV) and Beet soilborne mosaic virus (BSBMV) in soil samples collected from fields in Colorado(**A** and **B**, respectively), and Minnesota (**C** and **D**, respectively) from the small quadrats (3.4m × 7.6m) in 1999.*

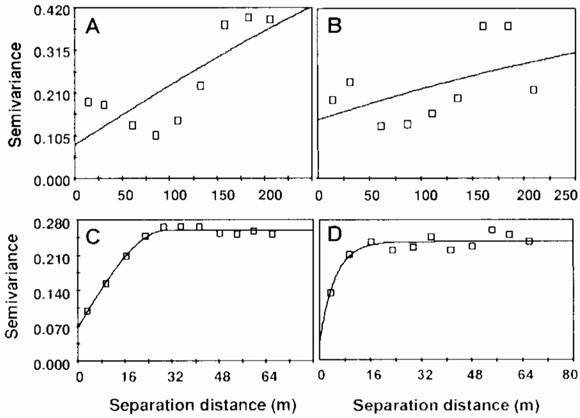

Fig. 2. Semivariograms of spatial patterns of *Beet necrotic yellow vein virus* (BNYVV) in samples collected from the small quadrats (3.4m × 7.6m) in Texas(**A**), and of BNYVV and *Beet soilborne mosaic virus* (BSBMV) (**B** and **C**, respectively) in samples collected from the large quadrats (0.4ha) from Minnesota in 1999.

CONCLUSION

The two-year investigation showed that BNYVV and BSBMV were present in all fields and were detected in greater frequencies singly than in association. The spatial distributions of both viruses varied among fields but were near random in most of the fields. Overall, both viruses exhibitedmore or less similar spatial patterns. Thus, similar sampling and management strategies can be instituted for both viruses.

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