



Distribution of *Barley Yellow Dwarf Virus* in selected districts of Southern, Northern and Central Zone of Khyber Pakhtunkhwa, Pakistan; A preliminary study

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Abstract

Barley Yellow Dwarf disease (BYD) is devastating disease of wheat in Khyber Pakhtunkhwa. Considerable losses were recorded in small grain cereals worldwide; BYD losses in wheat ranged from 20 to 30%. Keeping in view the importance and impact of *Barley Yellow Dwarf Virus* (BYDV) on wheat this study was carried out in three districts i.e. Peshawar, Bannu and Swat representing central, southern and northern zones respectively. Around 134 acres of area consisting of 58 wheat fields were assessed based on disease symptoms using assessment form for recording incidence, severity and field impact of BYDV. Overall mean BYD incidence observed was 6.69%, mean percent severity was 55.3% and mean BYD field impact factor (FIF) was 63.0. In District Peshawar total 17.87 acre area were surveyed, mean BYD incidence of 5.87%, mean percentage severity of 74.4% and mean BYD field impact factor of 60.8 was recorded. In Bannu district 89 acres area was surveyed and mean BYD incidence of 9.85%, mean percent severity of 55.35% and mean BYD field impact factor of 106.5 was observed. In Swat district 27 acre wheat fields were assessed and mean BYD incidence of 4.35%, mean percent severity of 36.15% and mean BYD field impact factor of 21.75 was confirmed. It is inferred that BYDV is an emerging viral threat in central, southern and northern wheat production zones of Khyber Pakhtunkhwa and should be included in regional wheat pathological issues regarding wheat improvement.

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Introduction

Barley Yellow Dwarf is economically important plant disease, which is caused by BYDV in cereals (Halbert and Voegtlin, 1995). In Pakistan, BYDV like symptoms were known since 1964 in the border areas of Pakistan and Afghanistan where it was confirmed for the first time in the country during 1987 (Aslam and Ahmad, 1987). BYDV has gradually attained an important position among wheat diseases (Khalid, 1999) and reported from Khyber Pakhtunkhwa Province of Pakistan (Saddiqi *et al.*, 2011) and Northern Punjab (Bashir *et al.*, 1987).

Prevalence of BYDV symptoms with varying level of chlorosis on commercial wheat varieties was recorded (Ibrahim and Jawad, 2015; 2006). These viruses are known for causing infection in Poaceae family. A complete assessment of host range of these viruses showed that it can infect round about 150 species in 5 of 6 subfamilies of the Poaceae and in 11 of the 25 tribes. Grasses, various lawns and weeds serve as alternative host in areas where cereals are planted in particular portion of a year (Van-Regenmortel *et al.*, 2000).

Barley Yellow Dwarf Virus is an important member of genus Luteovirus (Waterhouse *et al.*, 1988) in the family Luteoviridae (Miller *et al.*, 1988). Many important virulent strains causing infection in cereals belong to this group (Mayo *et al.*, 1989).

Luteoviruses are restricted to phloem tissues only and cannot instinctively pass on to other plants. All luteoviruses are composed of isometric particles, diameter of which ranges from 24-30 nm (Veidt *et al.*, 1988).

There are various strains of BYDV i.e. PAV (*Rhopalosiphum. padi*, *Sitobion. avenae* transmitted virus), MAV (*Sitobion. Avenae*), and SGV (*Schizaphis graminum*), while CYDV i.e. RMV (*R. maidis*) and RPV (*Rhopalosiphum. Padi*) (Zhang *et al.*, 2009). A new strain BYDV- GPV was identified in china which has no reaction to antiserum against MAV, PAV, SGV, RPV and RMV (Cheng *et al.*, 1996).

ICTV in its most recent report mentioned that BYDV-GPV is yet not considered a regular member of the Luteoviridae family. However, by analyzing and sequencing of its complete genome, based on similarity it is included in genus Polerovirus and *Wheat yellow dwarf virus* (WYDV-GPV) was proposed as new name (Bos, 1982).

BYD produce varying symptoms based on various factors including crop genome, age stage of plants during infection, virus species and other environmental conditions required for transmission. Plant host response to BYD is therefore extremely variable, which results in wheat yield losses. Infection caused by BYD disease has severe effects on quality and quantity of cereal crops. Multiplication of viruses in phloem has profound effects on physiological activities of plants. They destroy phloem tissues that result in reduction of translocation of assimilate produced by leaves (Gray and Gildow, 2003).

High disease incidence is recorded in moist seasons, therefore yield losses in wheat is high in autumn and spring. BYD disease can cause severe yield losses in winter barley and wheat, depending on seasonal conditions, vector occurrence, and agriculture practices. Considerable losses by BYD were recorded in small grain cereals worldwide (Pike, 1990), While in severe epidemic conditions, reduction in yield could reach up to 86% (Gill, 1980). Keeping in view the importance and impact of BYDV on wheat this study was carried out to record the overall incidence, percent severity and field impact factor of BYDV on wheat in high production zones of Khyber Pakhtunkhwa.

Materials and methods

Surveillance of barley yellow dwarf in Khyber Pakhtunkhwa

Survey was conducted in selected districts of Khyber Pakhtunkhwa to record data on 1) BYD incidence, 2) Severity, 3) Disease field impact factor (FIF).

$$\text{BYD Incidence} = \frac{\text{Diseased Plants}}{\text{Total No. of Plants Observed}} \times 100$$

BYD severity data was recorded according to 0-9 scale (Singh *et al.*, 1993). Field impact factor (FIF) for each field was calculated by using below mentioned formula;

$$\text{FIF} = \frac{\text{INCIDENCE} \times \text{Severity}}{\text{Zadok's growth}}$$

Crop growth stage assessment

Wheat growth stage in each field during the survey was determined by the commonly used growth stage key for cereals in which the development of the cereal plant is divided into 10 distinct development phases as described (Fig.1) (Zadok *et al.*, 1974).

BYDV infected leaf sample collection

BYDV infected/suspected wheat leaf samples based on typical BYD symptoms in shades of yellow, red or purple discoloration especially from leaf tip side toward base and from leaf margins toward midrib were collected from two locations of each Peshawar, Bannu and Swat districts representing central, southern and northern wheat production zones of Khyber Pakhtunkhwa in glassine bags and stored at 4°C at Plant Pathology Laboratory, Plant Protection Division, Nuclear Institute of Food and Agriculture (NIFA) Peshawar for onward processing. BYDV vectors were also collected during this survey from the three wheat production zones of Khyber Pakhtunkhwa in labeled glass vials 2x4cm containing

70% ethanol and identified in a parallel independent study as bird cherry-oat aphid (*Rhopalosiphum padi*), corn leaf aphids (*Rhopalosiphum maidis*), english grain aphid (*Sitobion avenae*) and green bug (*Schizaphus graminum*) which were sampled during this survey.

Results and discussion

Barley yellow dwarf virus surveillance

Around 134 acres of area consisting of 58 wheat fields were assessed based on disease symptoms for recording incidence, severity and field impact of BYDV. The surveillance study showed that overall mean BYD incidence was 6.69%, whereas mean percentage severity was 55.3% and mean BYD field impact factor (FIF) was 63.01 in Khyber Pakhtunkhwa.

Central zone

A total of 17.87 acre area comprised of thirty one wheat fields at Palosi (11.5 acre, 10 fields) and Tarnab (6.37 acre, 21 fields) in district Peshawar was surveyed (Fig. 2 & 3) While all the fields surveyed were infested with BYDV vectors and resulted into BYD symptoms expression (Fig.4 & 5). Highest mean BYD percentage incidence (6.5%), percentage severity (85%), and field disease impact (71.7%) were recorded at Palosi location while lowest i.e. 5.24%, 63.8%, and 49.9% were recorded at Tarnab location respectively (Table 1).

Table 1. Barley Yellow Dwarf Virus Surveillance in Khyber Pakhtunkhwa.

Parameters	Peshawar		Bannu		Swat	
	Palosi	Tarnab	Karim Basit Khel	Agri. Ext. Farm	Bagh Deri	Aghal
BYD Mean Incidence (%)	6.5	5.24	11.7	8	3.2	5.5
BYD Mean Severity (%)	85	63.8	56.7	54	34	38.3
BYD Mean FIF	71.7	49.9	130	83	13.5	30

Southern zone

We surveyed 89 acres area consisting of total of sixteen wheat fields i.e. Karim Basit khel (18 acre, 6 fields) and Government Agriculture Extension Farm (71 acre, 10 fields) for B.Y.D assessment (Fig. 2 and

3).The surveyed fields were found 100% infested with BYDV vectors and hence 100% BYD prevalence was recorded (Fig. 4 and 5). From the current study highest Mean percentage incidence (11.7%), percentage severity (56.7%), and field disease impact

(130) were recorded at Karim Basit khel location while lowest i.e. 8%, 54%, and 83%, were observed at Agriculture Extension Farm location as mentioned in (Table 1).

Northern zone

Swat district was surveyed with total wheat field area of 27 acre consisting of eleven farmer fields at Bagh Deri (8 acre, 5 fields) and Aghal (19 acre, 6 fields) locations as shown in (Fig. 2 and 3). It was observed that the prevalence of BYD vectors and BYDV was as high as in other studied regions.

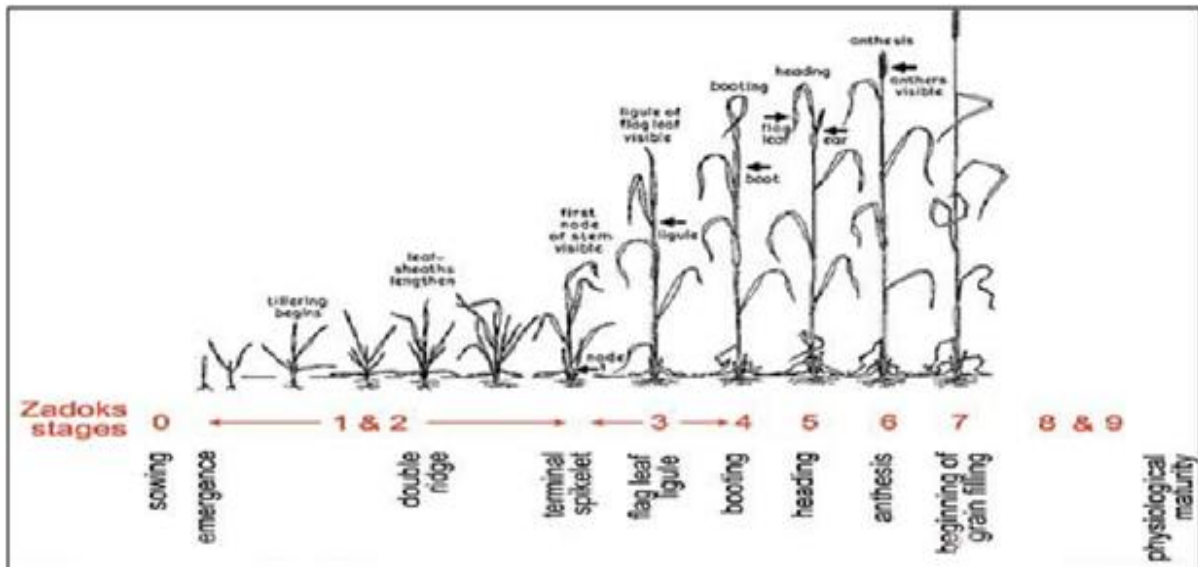


Fig. 1. Crop growth stage (Zadok et al., 1974).

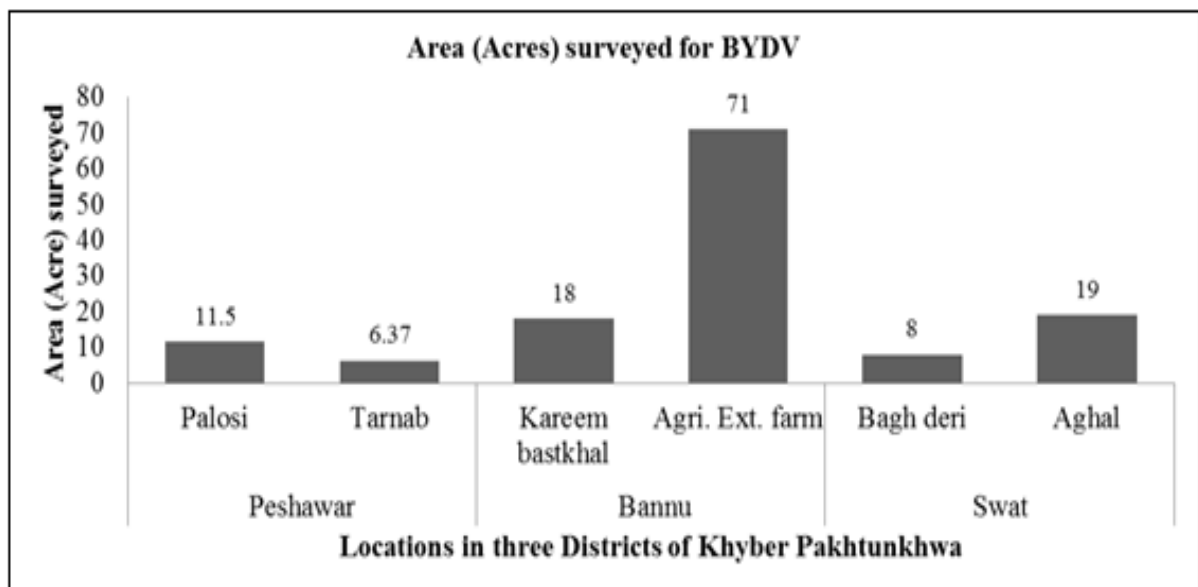


Fig. 2. Area surveyed for BYDV in three districts of Khyber Pakhtunkhw.

The infestation of BYDV vectors which transmitted BYDV and BYD symptoms expression are shown in Figure 4 and 5). Highest BYD mean percentage incidence (5.5%), percentage severity (38.3%), and field disease impact (30%) was confirmed at Aghal location while lowest i.e. 3.2%, 34%, and 13.5%,

respectively was recorded at BaghDeri location as given in (Table 1).

Literature study showed that BYDV has gradually attained an important position among wheat diseases and reported in Khyber Pakhtunkhwa and

Northern Punjab (Aslam and Ahmad, 1987; Saddiqui *et al.*, 2011). *Barley yellow dwarf virus* is one of important the pathogen of cereals including wheat. BYDV reduces 40% wheat yield each year (Gill, 1980). The prevalence rate of aphids in tested

regions was very high, which is one of important vector for BYDV transmission. Similarly the prevalence rate of BYDV in these regions was hundred percent.

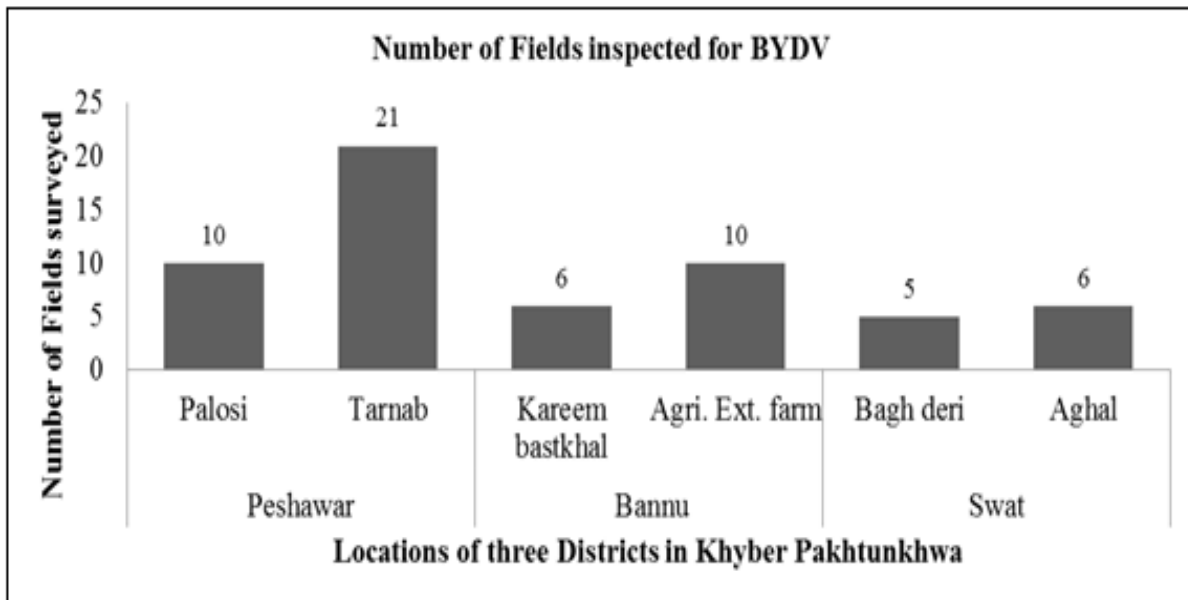


Fig. 3. Fields surveyed for BYDV in three districts of Khyber Pakhtunkhwa.

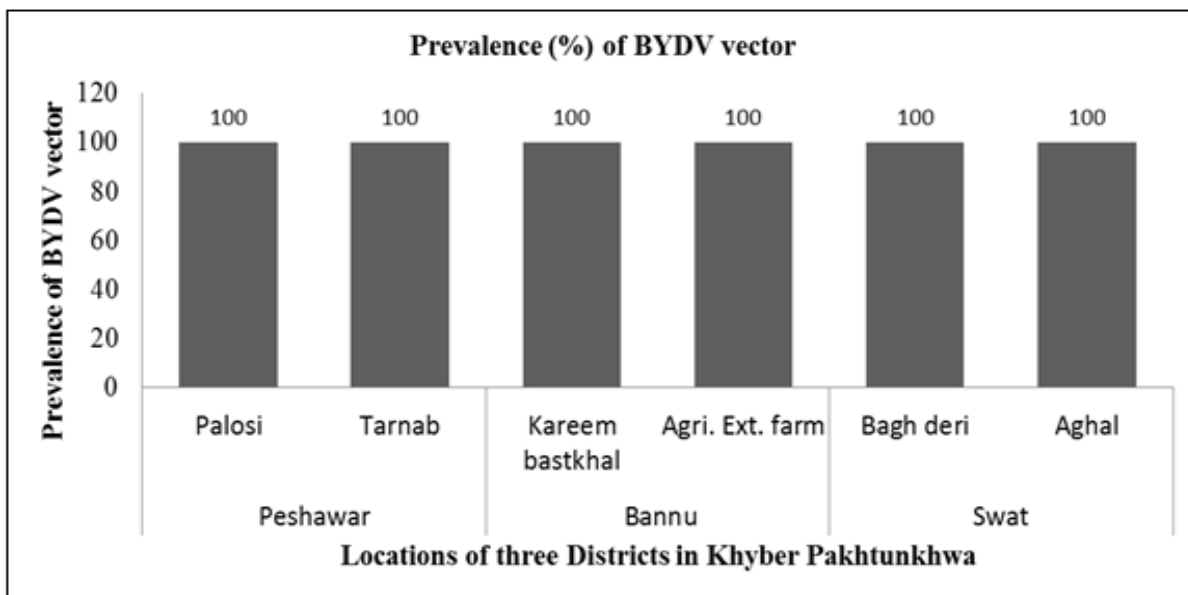


Fig. 4. Prevalence (%) of BYDV aphid vector in Khyber Pakhtunkhwa.

Overall high rate of infection were recorded in district Peshawar and all the fields surveyed were infested with BYDV vectors which transmitted BYDV and resulted into BYD symptoms expression. Similar study was conducted in 2015 in different districts of Khyber Pakhtunkhwa in which important and

efficient BYDV vectors i.e. *Rhopalosiphum. padi*, *Rhopalosiphum. maidis*, *Sitobion avenae* and *Schizaphus. Graminum* were identified and analyzed in abundance transmitting BYDV serotypes in wheat crop (Bashir *et al.*, 1997; Ibrahim and Jawad, 2015; Sawood *et al.*, 2015). Hence it is concluded that BYD

is a common and regularly occurring viral disease infecting wheat with leaf chlorosis and stunted growth symptoms across Khyber Pakhtunkhwa

representing central, southern and northern wheat production zone of the province.

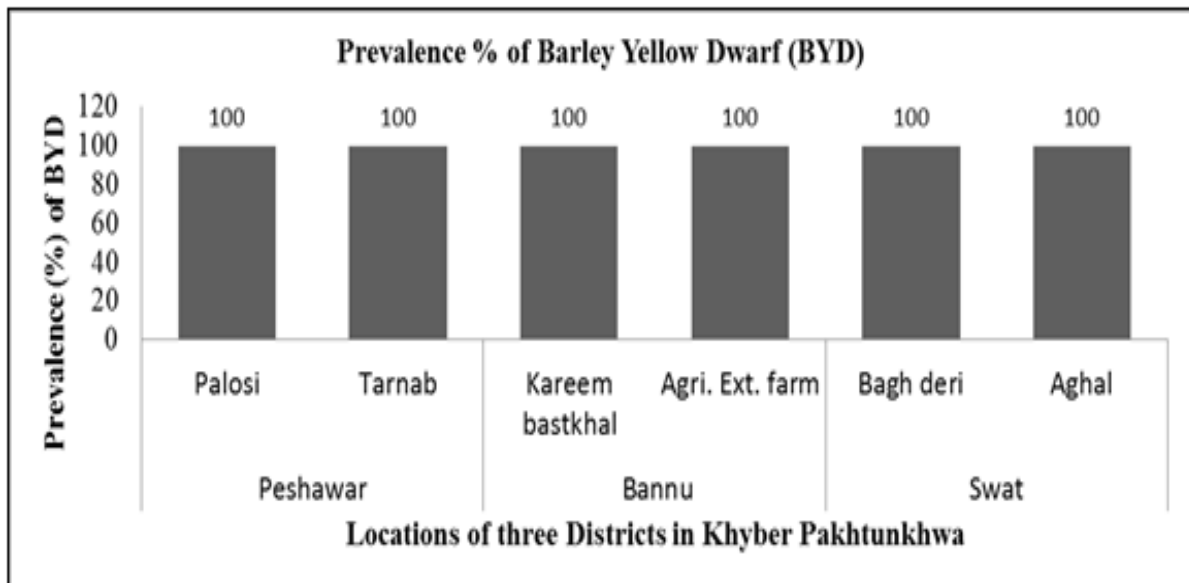


Fig. 5. BYD prevalence (%) in three Districts of Khyber Pakhtunkhwa.

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