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# Prevalence and Incidence of Onion Yellow Dwarf Virus (OYDV) Infecting Onion (*Allium cepa* L.) Crop in Indian Punjab

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**Abstract** Onion showed flattening of leaves, mosaic, curling, yellow stripes, twisting of scape, stunted growth and dwarfing type of symptoms during survey in 2014-15 under Punjab conditions. Mean disease incidence of OYDV was maximum in SAS Nagar (23.57%) followed by Patiala (19.13%), Ludhiana (12.21%), Amritsar (7.95%), Bhathinda (6.94%), Sangrur (6.3%) and Barnala (3.31%). Highest disease incidence was recorded in bulb to seed crop (30.17%) followed by table purpose (9.23%) and seed to seed crop (8.42%). In table purpose onion incidence was high in *kharif* season (10.91%) as compare to *rabi* (5.87%). Growth and yield parameters such as plant height, bulb size, seed weight were also affected by OYDV.

**Keywords** Symptoms, Prevalence, Incidence, Onion yellow dwarf virus.

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## Introduction

Onion is used as a spice and food in most parts of the world [1]. However, it has been valued for millennia also for medicinal properties [2]. India is the second largest producer with 19401.7 thousand MT production from 1203.6 thousand hectare area [3]. Although, it can be growth through length and breadth of the country, but Maharashtra, Bihar, Karnataka, Gujarat, Andhra Pradesh, Uttar Pradesh, Odisha and Madhya Pradesh are major onion growing states. Onion is attacked by fungi, bacteria, virus and phytoplasma. Among these virus disease is of great importance due to vegetative propagation of this crop. Viruses belong to genera *Potyvirus, Allexivirus* and *Carlavirus* are common in *Allium* species. Among potyviruses Onion yellow dwarf virus (OYDV) causes yellow dwarf disease in onion. In India, a serious outbreak of a virus-like disease was observed in onion seed crop in villages around Delhi and at the Farm of Associated Agricultural Development Foundation at Nazafgarh in Haryana State in December 1993. At Nazafgarh, 65% plants of onion cv Agrifound Light

**Table 1.** Prevalence and incidence of viruses associated with yellow dwarf virus in different onion growing districts of Punjab. *SI–Spot I, S2–Spot-2, S3–Spot-3, S4–Spot-4 and SC–Center spot.

| Location | Area (acres) | Variety | Date of sowing | Crop | Previous crop | Type of symptoms | % Disease incidence* S1 | S2 | S3 | S4 | SC | Average incidence % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| District: Patiala | | | | | Date of observation: 23-1-2015 | | | | | | | |
| Narayan-garh | 1 | Punjab Naroya | 10-11-14 | Bulb to seed | Basmati | Yellow stripe, severe yello-wing | 45.2 | 43.1 | 45.5 | 41 | 44.2 | 43.8 |
| | 0.5 | Punjab Naroya | 20-11-14 | Bulb to seed | Basmati | Mosaic, flatte-ned leaves | 34.5 | 33.2 | 46.6 | 30.8 | 25.1 | 34.04 |
| | 2 | Punjab Naroya | 4-11-14 | Seed to seed | Basmati | Flattened leaves | 6.2 | 7.5 | 6.7 | 5.6 | 4.8 | 6.16 |
| | 0.5 | Punjab Naroya | 19-11-14 | Seed to seed | Basmati | Flattened lea-ves with stun-ted plant | 10.5 | 5.2 | 8.1 | 15.5 | 10 | 9.86 |
| Nabha | 0.5 | PRO-6 | 12-11-14 | Seed to seed | Basmati | Clear yellow stripe, stunted growth | 5.1 | 7.5 | 8.6 | 10.8 | 15.4 | 9.48 |
| | 0.5 | PRO-6 | 15-11-14 | Seed to seed | Basmati | Flattened leaves | 15.8 | 8.4 | 9.6 | 10.9 | 12.5 | 11.44 |
| | | | | | | Mean | | | | | | 19.13 |
| District: SAS Nagar | | | | | Date of observation: 22-4-2015 | | | | | | | |
| Banur | 3 | Local | 24-10-14 | Bulb to seed | Bitter gourd | Mosaic, yellow streak | 25.2 | 20.5 | 15.8 | 17.1 | 30.2 | 21.76 |
| | 1 | Local | 20-1-15 | Table purpose | Potato | Curling, twis-ting and mosaic of leaves | 12.5 | 10 | 5.8 | 2.1 | 15.5 | 9.18 |
| Saneta | 2.5 | Local | 15-11-14 | Bulb to seed | Potato | Severe yello-wing, dwarfing | 30.2 | 25.8 | 32.2 | 40 | 20.6 | 29.76 |
| | 1 | Local | 5-11-14 | Bulb to seed | Potato | Yellow streak, twisted flower stalk | 25.5 | 34.6 | 50 | 45.5 | 10.9 | 33.3 |
| | 1.5 | Local | 12-11-14 | Bulb to seed | Potato | Crinkling, mosaic of leaves | 11.8 | 30.9 | 20.2 | 15.6 | 40.9 | 23.88 |
| | | | | | | | | | | Mean | | 23.57 |
| District: Ludhiana | | | | | Date of observation: 15-11-14 and 22-4-2015 | | | | | | | |
| Samrala | 15 | Rousy 18021 | 11-12-14 | Table purpose | Potato | Flattened, twis-ted Leaves | 4.3 | 10.1 | 3.2 | 5.6 | 8.5 | 6.34 |
| | 15 | Rousy 18021 | 10-1-15 | Table purpose | Sugarcane | Mosaic, Stun-ted growth | 5.2 | 5.5 | 14.7 | 20 | 5.2 | 10.12 |
| Ludhiana | 0.5 | Punjab Naroya | 25-11-14 | Seed to seed | Paddy | Yellow streak, distorted flower stalk | 3.5 | 2.6 | 10.1 | 5.6 | 4 | 5.16 |
| | 0.5 | Genetic stock | 28-12-14 | Table purpose | Onion, Brinjal | Flattened lea-ves with stun-ted plant | 4.2 | 8.6 | 4.6 | 10.1 | 5 | 6.5 |
| | 1 | Genetic stock | 2-1-15 | Table purpose | Pumpkin | Flattened leaves | 12 | 5.6 | 8.6 | 4.4 | 14.1 | 8.94 |
| | 0.5 | Genetic stock | 22-12-14 | Bulb to seed | Pumpkin | Yellow stripe, severe yello-wing | 22.2 | 30.1 | 42.3 | 36.6 | 50 | 36.24 |
| | | | | | | | | | | | Mean | 12.21 |

**Table 1.** Continued.

| Location | Area (acres) | Variety | Date of sowing | Crop | Previous crop | Type of symptoms | S1 | S2 | S3 | S4 | SC | Average incidence % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | District: Ludhiana | Date of observation: 15-11-14 and 22-4-1015 | | | % Disease incidence* | | | | | |
| | | | District: Sangrur | Date of observation: 28-5-2015 | | | | | | | | |
| Dhuri | 0.5 | Punjab Naroya | 11-1-15 | Table purpose | Onion nursery | Flattened leaves | 5.6 | 6.2 | 3.1 | 7 | 4.5 | 5.28 |
| Malerkotla | 1.5 | PRO-6 | 30-1-15 | Table purpose | Cauliflower nursery | Flattened leaves with stunted plant | 4.1 | 10.6 | 2.6 | 8.9 | 4 | 6.04 |
| | 1 | PRO-6 | 15-1-15 | Table purpose | Onion nursery | Mosaic, yellow streak | 9.1 | 11.2 | 5.6 | 7 | 3.9 | 7.6 |
| | | | | | | | | | | | Mean | 6.30 |
| | | | District: Amritsar | Date of observation: 29-5-2015 | | | | | | | | |
| Amritsar | 2 | Krish | 10-1-15 | Table purpose | Pea | Flattened leaves | 6.3 | 7.1 | 4.1 | 10.5 | 5 | 6.6 |
| | 1.5 | Krish | 12-1-15 | Table purpose | Pea | Flattened levels | 10.2 | 15.1 | 8.2 | 4.1 | 6.1 | 8.74 |
| | 2 | Vaibhav | 8-1-15 | Table purpose | Pea | Mosaic, yellow streak | 7.8 | 5.6 | 11.9 | 10.2 | 6.3 | 8.36 |
| | 1 | Krish | 5-1-15 | Table purpose | Pea | Flattened leaves | 4.4 | 6.9 | 7.5 | 11.6 | 10.1 | 8.1 |
| | | | | | | | | | | | Mean | 7.95 |
| | | | District: Barnala | Date of observation: 25-4-2015 | | | | | | | | |
| Barnala | 11 | Punjab Naroya | 18-1-15 | Table purpose | Potato | Flattened laves | 4.5 | 3 | 3.2 | 1.5 | 8 | 4.04 |
| | 3.5 | New field hybrid | 20-1-15 | Table purpose | Potato | Mosaic, yellow streak | 5 | 8.2 | 3.5 | 1.2 | 3 | 4.18 |
| | 3.5 | Prema | 25-1-15 | Table purpose | Potato | Mosaic, Stunted growth | 4.5 | 2.2 | 1 | 1.1 | 2 | 2.16 |
| | 7 | PRO-6 | 20-1-15 | Table purpose | Potato | Flattened leaves | 5 | 4.8 | 3.6 | 2.9 | 3 | 3.86 |
| | 5 | Punjab Naroya | 12-2-15 | Table purpose | Potato | Mosaic, Stunted | 1 | 2.1 | 3.2 | 4.2 | 1.1 | 2.32 |
| | | | | | | | | | | | Mean | 3.31 |
| | | | District: Bhathinda | Date of observation: 25-4-2015 | | | | | | | | |
| Bhathinda | 1 | LR-28 | 12-11-14 | Bulb to seed | Onion Nursery | Yellow streak, twisted flower stalk | 14.2 | 18.3 | 18 | 20 | 22.7 | 18.64 |
| | 4.5 | Rousy 18021 | 5-2-15 | Table purpose | Cotton | Flattened leaves | 3.2 | 4 | 2.2 | 1 | 1.1 | 2.3 |
| | 1 | Punjab Naroya | 15-2-15 | Table purpose | Rice | Mosaic, Stunted growth | 1.2 | 2 | 3.8 | 4.2 | 7 | 3.64 |
| | 1 | Hisar-4 | 15-2-15 | Table purpose | Cotton | Mosaic, yellow streak | 2 | 2.2 | 5.3 | 1.2 | 5.2 | 3.18 |
| | | | | | | | | | | | Mean | 6.94 |

Red in a three acre seed crop were affected. Similar disease was again observed in seed as well as main crop onion with equally high incidence during 1994 and 1995. A high incidence of OYDV (85–90%) was observed in seed crop in Hisar, Haryana [4]. Recently in 2010-11, a survey was conducted in 12 states to determine the presence of OYDV on garlic and related *Allium* spp. The highest percentage of OYDV positives were recorded from Maharashtra (96%) followed by Gujarat (75%) and Madhya Pradesh (75%).

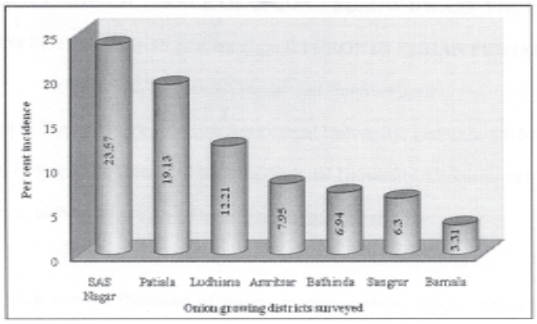


**Fig. 1.** Incidence of OYDV in different onion growing district of Punjab surveyed.

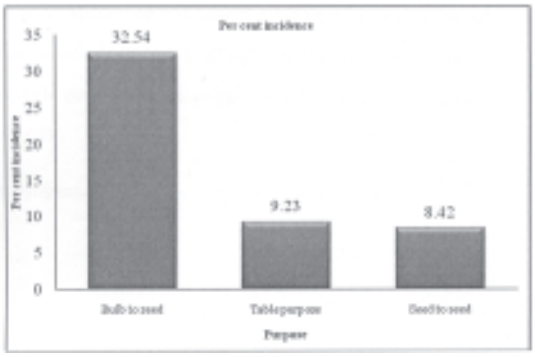


**Fig. 2.** Comparative incidence of OYDV in different onion crop.

The lowest percentage of OYDV positives were recorded from Rajasthan (25%) followed by Delhi (40%) [5]. Since the onion is propagated both by seed as well as bulbs. The accumulation and multiplication of virus in crops propagated by bulbs increase over the years resulted in drastic yield reduction. In Punjab, the onion production is coming in a big way and recent escalations in the price have made the onion cultivation as a lucrative option to the farmers.

## Materials and Methods

The survey for viruses infecting onion was undertaken in major onion growing areas of Patiala, Sangrur, Ludhiana, Amritsar, Bhathinda, Barnala and SAS Nagar of Punjab. The survey was conducted during December 2014 to April 2015. Total of thirty three fields spread over seven district were surveyed. The initial disease diagnosis in the field was based on characteristic symptoms. The per cent disease incidence was recorded randomly from different locations of each field i.e. four corners ($S_1$, $S_2$, $S_3$, $S_4$) and one central patch SC of $1m^2$ each by counting total number of plants and number of plants showing characteristic symptomatic virus infection using the formula given below:

$$\text{Per cent disease incidence} = \frac{\text{Number of infected plants}}{\text{Total number of plants observed}} \times 100$$

Besides the disease incidence, Date of observation, Location, area (acre), Name of variety, Date of sowing, Crop rotation, visual examination of characteristics foliage symptoms were recorded. Height of plants (cm), number of leaves per plant, diameter of leaves (cm), seed weight (g), bulb weight (g) and leaf weight (g) of infected as well as healthy plants, were recorded to estimated yield losses. Symptom variability caused by Onion yellow dwarf virus on onion in *kharif* and *rabi* season, were recorded.

## Results and Discussion

In order to study the prevalence and incidence of OYDV in the Punjab state, roving surveys were conducted in major onion growing areas of Punjab in districts viz., SAS Nagar (Banur and Saneta), Patiala (Narayangarh and Nabha), Ludhiana (Samrala and Ludhiana), Amritsar, Bhathinda, Sangrur (Dhuri and Malerkotla) and Barnala during 2014 and 2015 (table 1). Onion is grown in both *kharif* and *rabi* season under Punjab condition. In case of *kharif* season, only table purpose onion is grown where as in *rabi* season table purpose as well as seed purpose onion is grown. Seeds are produced by two methods most common method is bulb to seed (biennial cycle), where first year bulbs are produced and these bulbs are grown in October of second year to get seed by May. Another method is seed to seed method (one year cycle), where the seedlings are transplanted in the

month of September to get seeds in same year. Out of total area surveyed in *rabi* season 83.95, 11.76 and 4.27% crop area was under table purpose, bulb to seed and seed to seed type of crop, respectively. During survey, initial characterization was done on the basis of symptoms produced by OYDV on onion plants. Mainly three kinds of symptoms were observed during this survey: These include (i) Plant with flattened older leaves (ii) Yellow stripping on leaves, flattening and stunting of plant (iii) Severe twisting, thinning, partial and complete yellowing of leaves, stunting of plant and such plant did not bolt. This disease is known to cause curling and distortion of flower stem of onion. Yellow stripe, diffused chlorotic spots, twisting of leaves and mosaic type of symptoms were observed during 2007-08 at fields of Indian Agricultural Research Institute, New Delhi, India [4]. Mosaic and stripe symptoms were observed on stalks of flowers [6]. Results of comparative symptoms variability in two seasons revealed that symptoms were more prominent in *rabi* season crop with yellow stripe, dwarfing and stunting, drooping of older leaves and twisting of flower stalk. In *kharif* season flattening of leaves and severe yellowing were more common symptoms. Table 1 shows that mean disease incidence of OYDV was maximum in SAS Nagar (23.57%) followed by Patiala (19.13%), Ludhiana (12.21%), Amritsar (7.95%), Bhathinda (6.94%), Sangrur (6.3%) and Barnala (3.31%). Highest incidence in district SAS Nagar (Fig. 1) was recorded due to the maximum area was under bulb to seed crop. Due to accmulation and multiplication of virus in bulb, disease incidence was high in bulb to seed crop. Minimum mean disease incidence was recorded in Barnala followed by Sangrur. It was due to seed to seed type crop and virus is not seed transmissible. High incidence (64–71%) was recorded from seed production crop and 0–4% incidence from dry bulb production crop in Sudan [7]. Comparative incidence of OYDV in table purpose and seed purpose crops showed (Fig. 2) highest incidence was in bulb to seed crop (32.54%) followed by table purpose (9.23%) and minimum was in seed to seed crop (8.42%). OYDV caused drastic decline in seed yield, while seed vitality was not affected. Severity of damage caused by OYDV depends on the plant age at the time of infection. Epiphytotic caused by OYDV was observed in and around New Delhi in onion seed crop [6]. A high incidence of OYDV ranging from 85—90% was observed in seed crop at Hisar, Haryana [4]. In case of table purpose onion incidence was high in *kharif* season (10.91%) as compare to *rabi* (5.87%). OYDV was detected from both seasons crop in our survey but it was reported from *rabi* crop only in New Delhi [4]. Results of effect of OYDV on growth and yield parameter revealed that OYDV is responsible for reduction of height of plants by 16.89%, 12.24% reduction of number of leaves per plant, 1.50% reduction of diameter of leaves and leaf weight reduced by 71.43%. Significant reduction in case of yield parameters viz. seed weight (7.50%) and bulb weight (51.35%) was also observed. Reduction in different growth and yield parameter viz. pseudostem length, number of leaves, plant weight and bulb weight by 27.42, 29.14, 31.9 and 41.8%, respectively were reported from Egypt [8].

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