Viral Diseases of Chickpea

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Abstract

At least 16 viruses have been identified as natural chickpea pathogens in chickpea-producing countries. Chickpea viruses occur in the following groups: alfalfa mosaic virus, carlavirus, ilarvirus, luteovirus, nepovirus, pea enation mosaic virus, potyvirus, and rhabdovirus. The economic importance of these diseases needs to be determined. The relationship of sowing date, plant density, insect vector biology, environmental conditions, and alternative hosts to disease development and spread needs to be studied. Chickpea diseases caused by viruses are frequently attributed to other causes, such as soilborne pathogens. Losses due to virus diseases of chickpea can increase dramatically when the culture of the crop shifts from summer to winter sowing, as occurred recently in California, USA. Improved techniques are needed to detect, identify, and characterize viruses of chickpea, particularly those in the luteovirus group. Efforts at controlling major virus diseases of chickpea by various means, especially by host-plant resistance, need to be intensified. Breeding for disease resistance is an area where new technologies can play an important role in the not-too-distant future.

Résumé

Maladies virales du pois chiche : *Au moins 16 virus ont été identifiés comme étant les pathogènes naturels du pois chiche dans les pays producteurs. Les virus du pois chiche se trouvent dans les groupes suivants : virus de la mosaïque de la luzerne, carlavirus, ilarvirus, lutéovirus, népovirus, virus de la mosaïque verruqueuse du pois, potyvirus et rhabdovirus. L'importance économique de ces maladies devrait être déterminée. Le rapport entre la date de semis, la densité du peuplement, la biologie des insectes vecteurs, les conditions de l'environnement et les hôtes de remplacement d'une part, et le développement et l'extension de la maladie, d'autre part, devrait également être étudié. Les viroses du pois chiche sont souvent attribuées à d'autres causes, comme les pathogènes transmis par le sol. Les pertes occasionnées par les viroses du pois chiche peuvent s'intensifier de manière étonnante lorsque la culture passe des semis d'été aux semis d'hiver, comme cela s'est produit récemment en Californie, aux Etats-Unis. Des techniques améliorées sont nécessaires pour dépister, identifier et caractériser les viroses, particulièrement celles du groupe lutéovirus. Des efforts pour lutter contre les principales viroses du pois chiche par divers moyens, surtout à l'aide de la résistance de la plante-hôte, doivent être intensifiés. La sélection pour la résistance aux maladies est un domaine dans lequel des technologies nouvelles peuvent jouer un rôle important dans un avenir proche.*

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Table 1. Viruses occurring naturally in chickpea.

Virus group	Virus	Distribution	Primary inoculum reservoir	Method of transmission			Persistence[1]
				Sap	Seed	Vector	
Alfalfa mosaic	Alfalfa mosaic	Many countries	Alfalfa	+	-	Aphids	NP
Carlavirus	Pea streak	USA	Alfalfa	+	-	Aphids	NP
Cucumovirus	Cucumber mosaic	Many countries	Cucurbits	+	-	Aphids	NP
Ilarvirus	Tobacco streak	USA	Forage legumes	+	-	Thrips (?)	?
Luteovirus	Bean (pea) leaf roll	Many countries	Alfalfa	-	-	Aphids	P
	Legume yellows	USA	Alfalfa	-	-	Aphids	P
	Beet western yellows	Australia, USA	Many weed spp	-	-	Aphids	P
	Subterranean clover red leaf	Australia, USA	Forage legumes	-	-	Aphids	P
Nepovirus	Tobacco ringspot	India	ND[2]	+	ND	ND	ND
Pea enation mosaic	Pea enation mosaic	Italy, USA	Forage legumes	+	-	Aphids	P
Potyvirus	Bean yellow mosaic	India, Iran, USA	Forage legumes	+	-	Aphids	NP
	Chickpea bushy stunt	India	ND	+	ND	ND	NP
	Chickpea distortion mosaic	India	ND	+	-	Aphids	NP
	Chickpea filiform	USA	ND	+	-	Aphids	NP
	Lettuce mosaic	USA	Lettuce	+	-	Aphids	NP
Rhabdovirus	Lettuce necrotic yellows	Australia	Sowthistle	+	-	Aphids	P

1. NP = nonpersistent transmission; P = persistent transmission.
2. ND = no data.

Virus diseases of chickpea (*Cicer arietinum* L.) are found in most, if not all, countries where chickpeas are grown. Though their effects on yield and quality can be devastating, there is a need to determine the extent of losses caused by them. These diseases are frequently overlooked or attributed to other causes, such as soilborne pathogens. Research on viruses infectious to chickpeas was started by Snyder and his co-workers in California, USA in the 1950s. Subsequently, important strides have been made in different countries on the etiology, epidemiology, and control of virus diseases of chickpeas. However, significant gaps and confusion still exist in our knowledge of many chickpea virus diseases, notably those caused by luteoviruses.

Recent publications by Anjaiah et al. (1990), Ashby and Johnstone (1985), Bos et al. (1988), Bosque-Perez and Buddenhagen (1989, 1990), Kaiser et al. (1988), and Waterhouse et al. (1988) contain information relevant to the topic under discussion.

The Viruses

Sixteen viruses have been isolated from naturally infected chickpeas in different countries (Table 1). These viruses occur in the following groups: alfalfa mosaic virus, carlavirus, ilarvirus, luteovirus, nepovirus, pea enation mosaic virus, potyvirus, and rhabdovirus. Their identification is complicated by the occurrence of many strains that cause different diseases. At least four new viruses have been isolated from chickpeas since 1987. Most chickpea viruses belong to the luteovirus and potyvirus groups, with the former being more widely distributed and economically important.

Improved techniques are needed to detect, identify, and characterize chickpea viruses, particularly luteoviruses. Access to simple, inexpensive, and sensitive serological tests as well as antisera to known chickpea viruses would greatly aid in establishing the identity, distribution, and importance of these viruses. Although symptomatology, serology, and vector transmission tests are used to identify luteoviruses, additional research is needed to clarify relationships between luteoviruses infectious to chickpeas, especially by utilizing highly specific monoclonal antibodies and cDNA probes. The cause of chickpea stunt, a devastating disease present in many countries, is attributed to pea leaf roll virus (BLRV), a luteovirus. Research is needed to investigate the prevalence of other luteoviruses affecting chickpea.

Epidemiology

None of the viruses infecting chickpeas is reported to be seedborne in this host. In nature, all chickpea viruses, except tobacco ringspot (TRSV) and tobacco streak (TSV) are transmitted by aphids in a persistent (luteoviruses and rhabdoviruses) or nonpersistent (other virus groups) manner. TSV is transmitted by thrips, while the mode of transmission of TRSV to chickpea has not been established. Depending on the virus group, a few (luteoviruses and rhabdoviruses) or several aphid species (other virus groups) are potential vectors of these viruses under field conditions.

In California, USA, Bosque-Perez and Buddenhagen (1989, 1990) studied the effect of sowing date, aphid abundance, and species composition on the incidence of virus diseases in four chickpea cultivars. They found that virus incidence increased dramatically when chickpea culture shifted from summer to winter plantings. At least five aphid-transmitted viruses were isolated from infected chickpeas, and two luteoviruses (beet western yellows and subterranean clover red leaf) were the most prevalent and damaging. They observed that virus transmission began in early March and increased through April and that aphid populations peaked during this period. Virus infection reduced yields up to 100%. Epidemiological research on virus diseases is needed in other chickpea-growing regions of the world.

Alternative hosts play an extremely important role in the epidemiology of chickpea virus diseases. They serve as important reservoirs and overwintering hosts for viruses and their insect vectors. Some of the most important alternative hosts of the chickpea viruses are weeds and forage legumes, particularly alfalfa and clovers (Table 1).

Control

Host-plant resistance offers the most promising method of controlling virus diseases of chickpea. Relatively little has been done to develop chickpea germplasm with resistance to virus diseases. ICRISAT has identified several chickpea lines with field resistance to chickpea stunt (BLRV) in India and neighboring countries. However, this resistance did not hold up when lines were screened against a European isolate of BLRV (Bos et al. 1988). In the future, new technologies may contribute to the development of virus-resistant chickpea germplasm. For example, incorporation of the coat protein gene of a luteovirus into the genome of chickpea might cross protect the transformed plant against infection by one or more strains of the luteoviruses.

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