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Seed transmission studies of *Peanut bud necrosis virus* (PBNV) and *Tobacco streak virus* (TSV) isolates of blackgram and greengram of Telangana

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Abstract
Peanut bud necrosis virus (PBNV) and *Tobacco streak virus* (TSV) transmitted by thrip vectors have wide host range and becoming a serious threat to both agricultural and horticultural crops throughout India. Seed transmission of PBNV and TSV was tested in the present study, in blackgram(BG) and greengram(GG) by using PBNV-BG, PBNV-GG, TSV-BG and TSV-GG isolates of Andhra Pradesh in view of the earlier reports showing seed transmission in various crops at varying ranges. Five hundred numbers seed were collected from PBNV-BG, PBNV-GG, TSV-BG and TSV-GG infected blackgram cv.LBG-20 and greengram cv.K-851 plants and subjected to grow-out tests and DAC-ELISA. Grow-out tests did not exhibit any typical of PBNV/TSV symptoms under glasshouse conditions and none tested positive to DAC-ELISA, indicating no seed transmission of both the viruses *viz*., PBNV, TSV. But, the rate of germination of seeds from diseased plants varied from that of seeds collected from healthy plants. Blackgram seed collected from PBNV-BG, PBNV-GG, TSV-BG and TSV-GG infected blackgram cv.LBG-20 plants showed 79.2%, 72.8%, 68.0% and 70.4% germination, respectively while 89.6% germination was recorded with healthy blackgram seed. Whereas in greengram, seed collected from PBNV-BG, PBNV-GG, TSV-BG and TSV-GG infected greengram cv.K-851 plants showed 72.0%, 65%, 58.8% and 55% germination, respectively, while 86.4% germination was recorded with healthy greengram seed.

Keywords: Seed transmission, *Peanut bud necrosis virus* (PBNV), *Tobacco streak virus* (TSV), blackgram, greengram

Introduction
Among viral diseases attacking greengram and blackgram leaf curl disease caused by *Peanut bud necrosis virus* (PBNV) (= *Groundnut bud necrosis virus* – GBNV), *Tospo virus*, *Banyaviridae* (Amin *et al*., 1985) [1] transmitted by *Thrips palmi* (Karny) in a propagative manner (Sreekanth *et al.,* 2002a) [21] was considered to be a major threat, causing 40% yield loss (Nene, 1972) [9].

Recently, *Tobacco streak virus* (TSV), Ilar virus, *Bromoviridae* has also been reported to be a cause of leaf curl symptoms on blackgram (Prasada Rao *et al.,* 2003d; Ladhalakshmi *et al.,* 2005) [12, 8] and greengram (Bhat *et al.,* 2002c; Prasada Rao *et al.,* 2003d) paving confusion in field diagnosis to assess the disease incidence. Although both the viruses cause necrotic symptoms and are transmitted by thrips, the method of transmission and the virus vector relationship vary and hence need different approaches of management practices. It is necessary to identify and differentiate necrosis-causing viruses and their incidence on blackgram and greengram. Similarly, Seed transmission of viruses cause severe yield losses and it plays a major role in recommending integrated management practices of plant virus diseases. Transmission of plant viruses through seed is the most complex and important means of spread as the viruses persist for longer periods and can be invaded into new areas which result in alarming quarantine importance. Few strains of TSV are recorded to be transmitted by seed of some host species. TSV-parthenium and TSV-crownbeard were also seed transmitted in experimentally infected ageratum (*Ageratum houstonianum*) at rates of up to 40% and 27%, respectively (Sharman *et al*., 2015) [20]. In the present study, possible transmission of PBNV and TSV isolates of blackgram and greengram occurring in Andhra Pradesh in seed of experimentally infected, is investigated to follow appropriate management practices.

Materials and Methods
Seed transmission tests were done on laboratory inoculated plants. The susceptible checks,

blackgram cv.LBG-20 and greengram cv.K-851 were inoculated with the four virus isolates *viz*., PBNV-BG, PBNV-GG, TSV-BG and TSV-GG. All inoculated plants were maintained under glasshouse conditions and five hundred seed from each was collected. For the grow-out-test, seedlings were raised in trays filled with a sterilized potting mixture. Germination percent of seed sown was recorded. After two weeks, leaf samples collected from all the germinated seedlings were tested for the presence of the virus by DAC-ELISA using respective antiserum.

Results

The seedlings raised from 500 seed collected from PBNV-BG, PBNV-GG, TSV-BG and TSV-GG infected blackgram cv.LBG-20 and greengram cv.K-851 plants neither exhibited any typical of PBNV/TSV symptoms nor tested positive to DAC-ELISA, indicating no seed transmission of both the viruses in these crops. But, the rate of germination of seeds from diseased plants varied from that of seeds collected from healthy plants. Blackgram seed collected from PBNV-BG, PBNV-GG, TSV-BG and TSV-GG infected plants showed 79.2%, 72.8%, 68.0% and 70.4% germination, respectively while 89.6% germination was recorded with healthy blackgram seed. Whereas in greengram, seed collected from PBNV-BG, PBNV-GG, TSV-BG and TSV-GG infected plants showed 72.0%, 65%, 58.8% and 55% germination, respectively, while 86.4% germination was recorded with healthy greengram seed (Table 1).

Discussion

Although tospoviruses are not known to be seed transmitted, seed transmission of PBNV was tested both in blackgram and greengram in the present study in view of the earlier reports of TSWV seed transmission up to 96% in Cineraria and tomato (Jones, 1944) [6], whereas Crowly (1957) [4] found only 1% infection; the virus apparently carried in the testa, not in the embryo. In the present study, no seed transmission was observed in balckgram and greengram infected with PBNV-BG and PBNV-GG confirming the earlier reports of seed transmission of PBNV, in mungbean (Nene, 1972; Prasada Rao *et al*., 2003a) [9, 13] and urdbean (Nene, 1972; Prasada Rao *et al*., 2003a; Rajkumar, 2004) [9, 13, 16] and in peas (Prasada Rao *et al*., 1985; Reifschneider *et al*., 1989) [11, 19], tomato (Prasada Rao *et al*., 1980) [11, 10].

TSV-BG and TSV-GG isolates are not seed transmitted in blackgram and greengram among the 500 seed collected from mechanically inoculated plants. Seed transmission of TSV was reported in several crop species elsewhere in the world. Transmission of TSV through seeds was reported in number of hosts like asparagus (Valleau, 1940) [23]; *Phaseolus vulgaris* (Thomas and Graham, 1951) [22], *Datura stramonuim*, *C. quinoa* (Brunt, 1969) [2], black raspberry (Converse and Lister, 1969) [3], *M Melilotus alba*, *G. max*, *Gomphrena globosa*, *Nicotiana clevelandii*, *V. unguiculata* (Kaiser *et al.*, 1982) [7] and *Clematis vitabla* (Rana *et al*., 1987) [17]. Kaiser *et al*. (1982) [7] reported that the frequency of seed transmission was high in *G. max* (90%) and *C. quinoa* (86%) and less than 1% in V. *unguiculata*. TSV was seed borne in 0.7 to 90.6 per cent of the seed of artificially infected cowpea and *M. alba* Medik and in <3 per cent of the seed of naturally infected *M. alba* (white sweet clover) (Kaiser *et al*., 1991) [7] and in experimentally infected *C. quinoa* and naturally infected wild radish plants, *Raphanus raphanistrum* L. (Cupertino *et al*., 1984) [5]. High rates of seed transmission of TSV have been reported from soybean (up to 90 %) and common bean (26%) (Frison *et al*., 1990) [24]. Rana *et al*. (1987) [17] reported that the TSV-Cle isolate was seed transmitted in *C. vitabla* (70%) and *C. quinoa* (80%).

In India, to date TSV has not been reported to be seed-transmitted. Studies conducted on field infected and as mechanically inoculated plants of groundnut (Prasada Rao *et al*., 2003c; Reddy *et al*., 2007) [12, 18], sunflower (Prasada Rao *et al*., 2003b) [14], urdbean (Ladhalakshmi *et al*., 2006) [8], mungbean, marigold and parthenium failed to show seed transmission of TSV (Prasada Rao *et al*., 2003c, 2005) [12, 15]. Studies on seed transmission of TSV in uedbean cv. LBG-20 utilizing 368 and mungbean cv. K-851 utilizing 217 seeds harvested from TSV infected indicated that the virus was not seed transmitted in these crops (Prasada Rao, 2003a) [13]. Early infected peanut plants often die following field infection, so seed could only be collected from late infected plants. In ELISA tests although TSV was detected in the cotyledons of immature groundnut seed, but not in fully matured seeds and none of the seedlings grown from such seeds contained virus (Prasada Rao *et al*., 2003b) [14]. The findings of the present study are in concurrence with the reports of the previous workers.

Table 1: Seed transmission studies of PBNV and TSV in blackgram and greengram

Crop	Source of seed[a]	Total no. of seeds sown	No. of seeds germinated	Per cent germination	DAC-ELISA[b]
Blackgram	PBNV-BG	500	396	79.20	0
	PBNV-GG	500	364	72.80	0
	TSV -BG	500	340	68.00	0
	TSV-GG	500	352	70.40	0
	Healthy	500	448	89.60	0
Greengram	PBNV-BG	500	360	72.00	0
	PBNV-GG	500	326	65.20	0
	TSV -BG	500	294	58.80	0
	TSV-GG	500	279	55.80	0
	Healthy	500	432	86.40	0

a -Seeds were collected from blackgram and greengram plants inoculated with PBNV-BG, PBNV-GG, TSV-BG and TSV-GG isolates
b -DAC-ELISA result of germinated plant samples rose from seed collected from infected plants, against their respective antisera.

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