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MANAGEMENT OF PEANUT BUD NECROSIS DISEASE IN GROUNDNUT THROUGH TOLERANT VARIETIES

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ABSTRACT

Five groundnut varieties with different levels of resistance to PBND were experimented for three rainy and two post rainy seasons to analyse their effect on management of PBND. The results revealed that final PBND incidence, apparent infection rate. Area under disease progress curves (AUDPC) value were consistent with the respective variety. Further, 'TG-26' out yielded other varieties in terms of pod yield (1,112, 1,943 kg/ha in rainy and post rainy season respectively) with less apparent infection rate (0.003494) low PBND % (17.76) low AUDPC value (741) indicating its tolerance and better performance.

Key words : Groundnut, peanut bud necrosis disease, peanut bud necrosis virus, management, tolerant varieties.

Groundnut (*Arachis hypogaea* L.), a principal oilseed crop of the world is cultivated on 20.4 million hectares. In India, it is grown on 8.5 million hectares contributing to 55 per cent of the total oilseed production and rank's first in the world both in total area and production. However, the productivity is 800-900 kg/ha, which is below the global average production of 1,000 kg/ha. Biotic constraints are largely responsible for the loss of yields. Among the fungal diseases, rust, early and late leaf spots are important. However, they can be effectively controlled by a combination of host plant resistance and judicial use of fungicides. The other major diseases are of virus etiology. Among them, peanut bud necrosis disease (PBND) is considered to be the most important one and it is known to cause severe crop losses. PBND was first reported from India by Reddy *et al*., (1968) on groundnut. The causal agent of PBND was reported as tomato spotted wilt virus (TSWV) (Ghanekar *et al*., 1979). The causal virus was subsequently identified as a distinct Topsovirus and named as peanut bud necrosis virus (PBNV) Reddy *et al*. (1992) and its distribution is reported to be restricted to Asia.

The PBNV is widely distributed in India. Bud necrosis is one of the most devastating diseases affecting groundnut and other crops such as tomato, watermelon, chilli, brinjal, greengram, blackgram, and soybeans. It occurs at high incidence in some areas in the states of Andhra Pradesh (AP), Gujarat, Karnataka, Maharashtra, Rajasthan, Tamil Nadu, and Western Uttar Pradesh. In India alone, the loss due to PBND in groundnut was estimated to be Rs. 270 crores (ICRISAT medium term plan 1994-98). Losses depend mainly on the level of incidence and severity of symptoms. If the infection occurs on young plants (<60 days), pod yield loss will be cent per cent (Rao *et al*., 1984; Gopal and Upadhyaya, 1988). If infection occurs after the plants start to produce pods, losses are minimal.

Options for the management of plant virus diseases are adjustment of cultural practices, judicious use of chemicals for vectors and utilization of host plant resistance. In the absence of effective chemical control, research has to be done on cultural practices (Brown *et al*., 1996) for the management which might be modified to reduce the impact of PBNV on groundnut. In the case of TSWV, cultural practicessuch as date of planting, plant density and intercropping with

cereals have been shown to be effective for its management (Reddy, 1991). Epidemics of PBNV progress at slower rates on some groundnut cultivars, and host-plant resistance seems to be a promising method of disease management. In this direction management of PBND using varieties with different levels of resistance to PBNV were tested under epiphytotic field conditions for pod yield and tolerance to PBND and the results are reported here.

MATERIALS AND METHODS

Six groundnut varieties, two highly susceptible (JL 24 and K 134) and four field resistant ones (ICGS 11, TG 26, ICGV 86590 and ICGV 86031) were tested in three rainy and two post rainy seasons from 2000 to 2002 at Regional Agricultural Research Station (RARS), Jagtial (A.P.). Each variety was sown in four replications and each replication consisted of six rows of 5 m length with 40 cm between rows and 20 cm between plants. The genotypes were planted in randomized complete block design (RCBD). PBND incidence was recorded between 30 to 120, 35 to 142, 60 to 110, 45 to 142, 45 to 95 days after sowing (DAS) in 2000, 2000-01, 2001, 2001-02 and 2002 seasons, respectively. Infected plants were recorded by marking with coloured bamboo sticks as described below. AUDPC, D50%, PBND% and r values were calculated as described below. Pod yield, and shelling (%) were analysed statistically.

Marking PBND infected groundnut plants in the field

All PBND infected plants were marked with different coloured bamboo sticks utilizing an uniform colour for each set of recording. They were recorded at approximately 7 to 10 days interval starting from 30 DAS, until the crop attained maturity.

Area under disease progress curves (AUDPC)

To differentiate and select the best treatment/genotypes, the PBND incidence was quantified by using the following formulae and analyzed in RCBD (Nagarajan and Muralidharan, 1995).

$$A = \sum_{i-1}^{k} 1/2(S_i + S_{i-1})d$$

Where S_i = disease incidence at the end of the week i

k = the number of successive evaluations of disease

d = interval between two evaluations

Apparent rate of infection (r)

It was calculated by linear model (Y = b+ rt, after transforming the disease incidence as proportion (0-1) of PBND infected plants (Nutter ,1997) untill otherwise mentioned.

Statistical analysis

The angular transformed cumulative per cent PBND incidence data, the original data of pod yield, shelling and AUDPC values were analysed in RCBD and factorial RCBD (whichever applied) by using the statistical software Genstat 5 release 3.2. Non-linear growth models of Logistic and Gompertz were fitted using regression commands of Genstat in the construction of temporal disease progress curves.

RESULTS AND DISCUSSSION

There was sufficient PBND disease pressure during all the five seasons for effective screening of genotypes against the disease. The disease pressure was 95.63, 49.4, 83.37, 40.33 and 44.41% PBND during 2000, 2001, 2002 rainy season 2000-01 and 2001-02 post-rainy season, respectively. During all the test seasons PBND % occurred first and high in susceptible check JL 24. Five genotypes, ICGV 86031, ICGV 86590, ICGS 11 (field resistant), TG 26 (new variety in the process of release) and K134 (newly released variety) were tested. In three rainy and two post-rainy seasons under high disease pressure. The final disease incidence, apparent infection rate and AUDPC value were consistent in all the seasons tested with respect to resistant level of the genotypes. This indicates the significance of genotypic effect on PBND incidence and AUDPC. The performance of all the field resistant genotypes with respect to yield and AUDPC were on par (Tables 1,2).

However, the apparent infection rate and PBND incidence, always less and pod yield (mean yield of 1112 kg/ha in rainy and 1943 kg/ha in post-rainy seasons) was higher in TG 26 indicating its better performance compared to other field resistant genotypes (Tables 1, 2). While the high yielding susceptible check JL 24 showed higher PBND incidence (95.63, 49.4, 83.37 in 2000, 2001, 2002 rainy seasons and 40.33, 44.41 in 200001 and 2001-02 post-rainy seasons, respectively), high infection rate (0.0124, 0.0098, 0.01165 during 2000, 2001, 2002 rainy seasons; 0.00364, 0.00487 in 2000-01. 2001-02 post-rainy seasons, respectively). Higher AUDPC value found to be attributed to lower pod yields (719 and 1398 kg/ha of mean pod yield in three rainy and two post-rainy seasons, respectively).

Growing field resistant varieties seems to be a promising method of disease management in general and particularly against viral diseases. PBND progress at slower rate on some groundnut cultivars was observed. The mechanism of resistance is not yet understood but it may be because of differential thrips preferences for groundnut cultivars.

Field resistant varieties effect on PBND suppression, revealed that the susceptible cv. JL 24 always had higher incidence, higher AUDPC and higher apparent infection rate compared to other varieties. TTG 26 was found promising in suppressing the PBND by slow progress of the disease, low final incidence, low AUDPC and significantly out yielded all the genotypes in rainy season except ICGV 86590. It was on par in yields with ICGS 11 and superior to rest of the varieties especially in post-rainy season. There are no reports on temporal disease progress curves (TDPC) of PBND in groundnut. Cuibreath *et al*. (1992 and 1994) studied the TDPC on TSWV at Georgia in groundnut cvs, Southern Runner, Georgia Browne and Florunner and reported that the final incidence and apparent infection rate were higher in Florunner than Southern Runner and Georgia Browne. The present studies also showed that the field resistant high yielding varieties significantly suppressed the PBND by slow progress of the disease. These results are supported by Arnin (1985) and Culbreath *et al*. (1992 and 1994). Amin (1985) also reported that there was lower infestation of thrips under field tests on field resistant 'R 33-1' than susceptible 'TMV 2'. Under laboratory, R 33-1 did not adversely affect the longevity and fecundity of F.schultzei . With these results he was of opinion that non-preference of thrips for cv. R 33-1, resulted in low incidence of TSWV. Therefore, these reports are in support of non-preference of thrips for cv. TG 26 which resulted in low incidence of PBND.

The studies indicate that final PBND incidence, apparent infection rate, AUDPC value were consistent with the respective genotype/variety. Further, TG-26 out yielded other genotypes in terms of pod yield (1112, 1943 kg/

Table 1. Pod yields of six groundnut genotypes that showed different levels of PBND resistance during 3 rainy and 2 post rainy scasons, at RARS, Jagtial (A.P.) during 2000-2002

Genotype	Pod yield (kg/ha)						
	Rainy season				Post rainy season		
	2000	2001	2002	Pooled[a]	2000-01	2001-02	Pooled[a]
JL 24	733	829	774	779	1386	1409	1398
K 134	793	896	736	808	1493	1511	1502
ICGS 11	965	998	974	979	1890	1989	1940
TG-26	4429	1139	1068	1112	1913	1972	1943
ICGV 86590	1089	1164	1102	1118	1606	1584	1595
ICGV 86031	943	1020	953	972	1464	1579	1521
S (m ±)	66.4	68.40	61.9	–	85.9	100.6	–
LSD (=0.01)	100.00	103	63.52	52	129	152	90
CV%	6.98	6.92	6.36	6.54	5.29	6.01	5.4

a= In pooled analysis, genotypcs are significant LSD (P<0.001), CV (%) are presented above and years are not significant (P=0.05).

Table 2. PBND incidence, AUDPC and apparent infection rates for 6 groundnut genotyps that showed different levels of resistance to PBNV during 5 seasons (2000-2002) at RARS, Jagtial (AP).

genotypes	Final PBND (%)					AUDPC					Apparent infection rate[a]				
	Rainy season			Post rainy season		Rainy season			Post rainy season		Rainy season			Post rainy season	
	2000	2001	2002	2000-01	2001-02	2000	2001	2002	2000-01	2001-02	2000	2001	2002	2000-01	2001-02
JL 24	95.63 (9.83)	49.40 (7.09)	83.37 (9.18)	40.33 (6.39)	44.41 (6.74)	3674	1079	3448	2023	2553	0.0124	0.0098	0.01165	0.00364	0.00487
K 134	85.15 (9.28)	46.12 (6.84)	93.28 (9.71)	35.53 (6.04)	39.90 (6.39)	3110	918	3907	1944	2169	0.0114	0.00869	0.01281	0.0032	0.00443
ICGS 11	36.34 (6.11)	18.29 (4.65)	50.07 (7.17)	18.66 (4.43)	7.47 (2.90)	918	413	1893	893	434	0.0041	0.0013	0.0086	0.00158	0.00081
TG-26	13.54 (3.80)	12.83 (3.68)	34.32 (5.93)	13.18 (3.76)	14.93 (93.98)	540	454	1203	734	774	0.0061	0.0023	0.0062	0.00102	0.00185
ICGV 86590	26.77 (5.27)	9.91 (3.20)	27.53 (5.22)	11.30 (3.50)	9.23 (3.06)	723	161	945	539	471	0.0031	0.00175	0.00495	0.00098	0.00117
ICGV 86031	26.43 (5.23)	10.49 (3.35)	32.54 (5.77)	12.60 (3.67)	10.20 (3.34)	654	172	1106	482	459	0.00293	0.00199	0.0061	0.00109	0.00009
SE (m±)	(0.0762)	(0.2617)	(0.115)	(0.055	(0.084)	138.6	61.0	147.2	103.5	96.8					
LSD (P= 0.01)	(0.2128)	(0.2617)	(0.322)	(0.155)	(0.236)	417.7	183.8	443.7	311.8	291.8					
CV%	13.70	17.80	10.00	10.80	14.40	17.3	28.2	14.1	18.8	17.4					

a = Apparent infection rate estimated by linear equation, y = b + rt

h in rainy and post-rainy seasons, respectively) with less apparent infection rate (0.0061, 0.0023, 0.0062 in 2000. 2001. 2002 rainy seasons; 0.00102, 0.00185, during 2000-01, 2001-02 post-rainy seasons, respectively), low PBND % (13.54, 12.83 and 34.32 during 2000, 2001. 2002 rainy seasons: 13.18. 14.93 during 2000-01 and 2001-02 post-rainy seasons, respectively) low AUDPC value (540, 454, 1203 during 2000, 2001. 2002 rainy seasons respectively; 734, 774 during 2000-01 and 2001-02 post-rainy seasons, respectively) along with less number of *T. palmi* population (6/30 leaves at 60 DAS, 7/30 leaves at 95 DAS, 8/30 leaves at 60 DAS during 2000, 2001, 2002 rainy season, respectively) indicating its better performance.

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