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RESEARCH ARTICLE

Transfer of foliar disease resistance by crossing *Arachis hypogaea* and wild species

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SUMMARY

LLS, is an important fungal disease of groundnut. To introduce LLS resistance from diploid wild species into tetraploid cultivated *Arachis hypogaea*, synthetic amphidiploids ISATR 278-18 and ISATGR- 5B was used as donor parent to generate a backcross population and screened for resistance to LLS. Hybrids in different generations were scored for rust and LLS resistance and found that they were resistant for all components of disease resistance as compared to female parent. Thus crosses with species outside the section *Arachis* may not only confer disease resistance but will also broaden the genetic base of cultivated peanut.

Key Words : Groundnut, Wild species, Synthetic amphidiploids, Interspecific hybridization

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Cultivated groundnut, also known as peanut (*Arachis hypogaea* L.), is grown on nearly 24 million hectares between latitudes 408 N and 408 S. Late leaf spots (LLS), caused by *Cercosporidium personatum*, and are an important foliar disease of groundnut in Africa, Asia and the Americas. An estimated global loss in yield of 600 million US$ due to LLS has been reported (Dwivedi *et al.,* 2003). Hence, yield losses due to the disease can be a major impediment to groundnut production. Managing the disease through the application of fungicides is not a viable option for resource poor farmers. Besides, the application of fungicides may pollute the environment, including ground water, thus causing greater risk and damage than the loss of the crop due to the disease. Wild species from the section *Arachis* have been used in the improvement of cultivated species (Stalker *et al.*, 1991 and Mallikarjuna *et al.*, 2004a, b). Wild species in the other eight sections are incompatible with the cultivated peanut and specialized techniques are required for crossing. Synthetic amphidiploids ISATGR 278-18 and ISATGR 5B are resistant to late leaf spot and rust. Utilization of synthetic amphidiploids in an *A. hypogaea* improvement program could contribute resistance to LLS and rust in cultivated varieties and would broaden the genetic base of the crop.

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MATERIAL AND METHODS

Seeds of synthetic amphidiploids ISATR 278-18 (*A.duranesis* ICG 8138 *X A.batizocoi* ICG 13160) and ISATGR- 5B (*A.magna* ICG 8960 x *A.batizocoi* ICG 8209) with 2n=2x=40 were obtained from the ICRISAT and grown in a glasshouse. These amphidiploids established in the ring pots were screened for late leaf spot (LLS) resistance by detached leaf technique in laboratory by studying the component traits. Cultivar TMV 2 and JL 24 were used as the susceptible check. Plastic trays with autoclaved sand were used to place tetrafoliate leaves in a Randomized Block Design with 2 replications. LLS spores were harvested with a cyclone spore collector. The concentration of the suspension was

20,000 spores/ml. A few drops of tween 80 (polyoxyethylene sorbitan mono-oleate) were added. Spore suspension was used to spray inoculate the leaves. Immediately after inoculation, leaves were placed in a growth room at 23–25°C to ensure wetness of the leaf surface during the night. Leaves were observed for damage due to sporulating colonies and time taken to sporulation. Based on these parameters damage due to LLS was calculated at the end of 30 days. The screening was carried out in the glasshouse under unprotected condition. Both amphidiploids were found to be resistant to LLS. Seeds of *A. hypogaea* cv. ICGV 91114; ICGS 76, ICGV 91278, JL 24 and DH 86 were also grown in the pots. Flowers were emasculated a day before pollination and cross pollination, using *A. hypogaea* as the female parent and synthetic amphidiploids as the pollen donor, was carried out before 10:00 am on the following day. Pollination was done up to 30 days and numbers of bud pollinated were recorded. Peg formation was started after 25 days of stopping of pollination. Hybrid pods were harvested 45 days after pegging and per cent crossed pods were calculated in both of the amphidiploids. The F_1 seeds were germinated to raise hybrid plants. Backcross populations, BC_2F_1 were developed by crossing F_1 with 5 cultivated recurrent parents which were selfed to produce BC_2F_2.

RESULTS AND DISCUSSION

Seed set in crosses involving ISAT 278-18 as the pollen parent was very low (15 to 45%). Crosses involving ISATR 5 as the pollen parent showed pod formation ranging from 16 to 47%. The F_1 seeds were germinated to raise hybrid plants. F_1 hybrid had intermediate morphology with a spreading growth habit (Fig. 1). The seeds were germinated to backcross the F_1 hybrids with the respective recurrent parent. F_1s were backcrossed to five cultivated types to raise backcross population (Table 1). Percentage of crossed pod ranged 38 to 50% which was 50% of the no. of bud pollinated. These BC_1F_1s hybrids of five cultivated lines were selected based on disease resistance and then backcrossed again with two recurrent parents to raise BC_2F_1s. Selected no. of BC_2F_1s hybrids in each of the ten crosses was selfed and screened for resistance to rust and LLS under high disease pressure during *Kharif*. Selection was made based on disease response and morphology. Hybrids in different generations were scored for rust and LLS resistance and found that they were resistant for all components of disease resistance as compared to susceptible female parent (Fig. 2). Number of resistant plants in each cross and generation and their range of disease scores is indicated in Table 2. Many of the wild species from section

Table 1: Backcrossed population

Crosses	No. of true F_1s	No. of buds pollinated (BC_1)	% crossed pods	No. of crossed pod in (BC_1)
JL 24 x (JL 24 x ISATGR 278-18)	6	90	42	54
JL 24 x (JL 24 x ISATGR 5)	13	95	41	16
DH 86 x (Dh 86 x ISATGR 278-18)	7	40	50	5
DH 86 x (DH 86 x ISATGR 5)	5	52	45	6
ICGS 76 x (ICGS 76 x ISATGR 278-18)	2	76	41	13
ICGS 76 x (ICGS 76 x ISATGR 5)	3	83	45	9
ICGV 91114 x (ICGV 91114 x ISATGR 278-18)	4	97	47	23
ICGV 91114 x (ICGV 91114 x ISATGR 5)	5	87	38	17
ICGV 91278 x (ICGV 91278 x ISATGR 278-18)	6	53	47	40

Fig. 1 : Female parent JL 24 and its hybrid with amphidiploid ISATGR 5

Table 2: Number of resistant plants in each cross and generation

Crosses	BC_2F_2	BC_2F_3	BC_1F_3	F_3	F_4	Total
DH 86 x (Dh 86 x ISATGR 278-18)	5	10	14	-	-	29 R
DH 86 x (DH 86 x ISATGR 5)	-	9	7	2	-	18 R
ICGS 76 x (ICGS 76 x ISATGR 278-18)	15 (MR)	10 (MR)	90 R + 20 MR	11	5	101 R + 45 MR
ICGS 76 x (ICGS 76 x ISATGR 5)	20 (MR)	6 (MR)	-	2	6	8 R + 26 MR
JL 24 x (JL 24 x ISATGR 278-18)	8 (MR)	6	-	-	-	6 R + 8 MR
JL 24 x (JL 24 x ISATGR 5)	5 (MR)	-	-	-	-	5 MR
ICGV 91114 x (ICGV 91114 x ISATGR 278-18)	-	-	2	-	-	2 R
ICGV 91114 x (ICGV 91114 x ISATGR 5)	-	-	-	2	-	2 R
R= Complete resistant; MR = Moderate resistance						166 R + 84 MR

Fig. 2 : Comparison of resistant BC2F2 hybrids of cross ICGS76 x ISATGR 278-18 and susceptible female parent

Arachis have been successfully crossed with *A. hypogaea* and hybrids obtained (Stalker *et al*., 1991 and Mallikarjuna *et al*., 2004a, b) and various introgression schemes have been used to obtain backcross progeny (Simpson, 2001). In the present experiment, F_1 hybrid was used as the male parent and crossed with *A. hypogaea*. Synthetic amphidiploids when crossed with *A. hypogaea*, produced fertile plants and the pods resembled those of *A. hypogaea*. *Arachis glabrata* from section Rhizomatosae has been successfully crossed with *A. hypogaea* using in vitro techniques (Mallikarjuna and Sastri, 2002) and traits of interest such as resistance to late leaf spot and groundnut viral diseases caused by peanut mottle virus (PMV), peanut stripe virus (PSTV) and peanut bud necrosis virus (PBNV) transferred (Mallikarjuna, 2003). In the present study, it was possible to transfer level of LLS resistance from synthetic amphidiploids.

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