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New Cotton Varieties for Thai Farmers

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ABSTRACT

DORAS Project initiated in 1991 a cotton-breeding program in Thailand. After six years of breeding, the first wave of new variety creations is now available. The varieties were obtained by transferring into an agronomically well-adapted Thai genetic base (SSR 60) characters which improve its economic potential (gossypol free, coloured lint) or its agronomic quality (okra leaf, frego bract). These are the following varieties: DORA 11 (frego bract, highly productive, good earliness), DORA 21 (glandless seed, productive with a good tolerance to shedding, good fiber quality), DORA 31 (okra leaf, frego bract and good technological traits), DORA 41 (brown coloured fiber). DORA 11 may be adopted by farmers in the next years. Assessment of the other genotypes still needs additional experiments. As far as seed production of glandless varieties, like DORA 21, is concerned, avoidance of genetic mixing demands well-coordinated procedure.

Key words: cotton breeding, variety and fiber

INTRODUCTION

A cotton improvement program has to take into account desires of farmers, ginners and spinners.

- Farmers ask for (1) high seed-cotton yield which depends on physiological and agronomic behavior, (2) tolerance to pests; the major pests are *Helicoverpa armigera* (American bollworm) and *Aramsca biquttule biguttula* (jassid) and hairiness on the leaves is known to have positive control effects on the latter pest (Agarwal *et al.*, 1978) and (3) tolerance to diseases: the major diseases are bacteriosis and leaf roll ("blue disease").

- Ginners expect for high lint yield of seed cotton (Ginning-Out-Turn; GOT) and desirable contents of some component like oil and gossypol in the kernel.

- Spinners require high lint quality, which depends on length, strength, maturity and fineness of the fiber.

When the DORAS (Development Oriented Research or Agrarian Systems Project) cotton improvement program started in 1991, the objectives corresponding to short, medium and long terms were defined.

For short term, the purpose was to introduce new germplasms and to identify suitable foreign varieties. A programme of crossing between complementary germplasms has been undertaken in order to obtain

At long term new varieties with high yielding potential, hairy leaf (tolerance to jassids), leaf roll resistance and improved technological traits (GOT, length, strength). Such a work being time

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consuming (at least 7 to 10 years) was set up to reach at medium term by using the back-cross method. Back crossing allows to rapidly improve one recurrent parent with an agronomic or economic trait controlled by oligogenic determinism (Allard, 1960).

This method enable to modify one character of a variety with keeping unchanged other characters controlled by the genetic background of the recurrent parent. For this program, four traits have been chosen: gossypol-free trait, as this allows to enlarge human and animal feeding use of cotton kernels (Bourely and Hau, 1991), (2) coloured lint trait, as the commercial value of this fiber could be high, (3) "frego bract" (narrow and twisted bract) as earliness and chemical protection of the bolls could be improved and boll-rot risk mitigated (Thomson, 1994). The Thai variety Srisamrong 60 (SSR 60) was chosen as recurrent parent, owing to its good yielding potential and in spite of some inconveniences like its glabrous leaf and its leaf roll disease susceptibility.

This paper presents the first varieties created by the DORAS Cotton Improvement Program, as medium term outputs. Releasing conditions of these new genotypes are discussed.

MATERIAL AND METHODS

Main activities of conventional breeding program were carried out at Suwan Research and Training Station of Kasetsart University in Thailand. Due to irrigation facilities, this enables to enhance breeding program with two cotton crops per year, CIRAD-CA[1] remained the principal supplier of cotton germplasms and managed a large part of fiber and yarn analyses. However, numerous fiber analyses were also carried out with help from the Textile Industry Division and the Phiphatanakit Textile Co.,Ltd. The cooperation for cotton research has been enlarged since 1994-95 crop season with D.O.A. Extension Service participated to test DORAS material at field level.

SSR 60 was used as recurrent genotype. Generally, three back crosses should be enough to recover agronomic background of the recurrent variety. However, Single plants were selected before the third back-cross. They were genetically stabilized with self-pollination, then tested on station and, for DORA 11 and DORA 21, on farm trials. The donor parents corresponding to each trait were the following:

Frego bract character: varieties IG 22 and IG 1600 (okra-leaf and frego-bract genotypes originated from Australia) were involved in panmixy (crosses without male parent identification). Plant selection has permitted to isolate a genotype, homozygous for the frego bract character and remarkable for its agronomic behavior. This genotype has been named DORA11. On station experiment started in 1994-95 season and multilocation tests were carried out in 1995-96 and 1996-97.

Glandless character: variety CA 412, genotype created by CIRAD with IDESSA[2] from an inter-specific background of *G. hirsutum x G. arboreum G. raimondii* (HAR). A bulk of off-springs was built, then genetically stabilized by self-pollination to increase homozygozity for the glandless character. Experiment started with two tests in 1996-97 season, one at Suwan Research and Training Station and another in Lopburi. This variety has been named DORA 21.

Okra-leaf character: this trait is associated

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to 'frego' bract in the Australian IG 22 variety. Offspring led to a population named DORA 31, homogeneous for both okra and frego characters. On-station experiment started only in 1996-97 season.

Coloured lint character: mutant Lc1 ("Lint coloured 1", Endrizzi *et al.*, 1984), transferred on the TM1 ("Texas Marker 1") genetic background was provided by Texas University (College Station-USA). Offspring led to a brown coloured lint variety named DORA 41, experimented on Suwan Research and Training Station in 1996-97.

Tests were carried out with statistical designs (Balanced Lattice for on station trail and Randomized Complete Bloc for on farm trial). Plots were composed of 3 to 4 rows: neighboring effect was controlled by using middle rows for agronomic and technological measurement analysis. SSR 60 was the check-variety, except for glandless tests of which DORA 21 was compared to CA 413, a glandless variety from Africa. The reason of this exception is the risk of higher susceptibility to pests of glandless material compared to gossypol one. Glandless varieties get an attractive effect on pests, leading to wrong yielding in favor of glanded genotypes. This attractive effect disappears when free gossypol varieties are grown on large area. In this last case, the pest pressure is diluted and glandless genotypes express well their yield potential (Vaissayre and Hau, 1985)

RESULTS

At the end of the rainy season 1996-97, DORAS achieved to propose one new germplasm (DORA 11) for registration and to recommend three other ones (DORA 21, DORA 31 and DORA 41) for wider experiments.

DORA 11

This variety has been created during 1993-94 crop season. The results of three-year experiments are shown in Tables 1 and 2. DORA 11 appears to be better than SSR 60 for seed-cotton yield (+ 17% by average) and earliness. Under conditions leading to low yield level in on-farm experiment, superiority of DORA 11 is over more

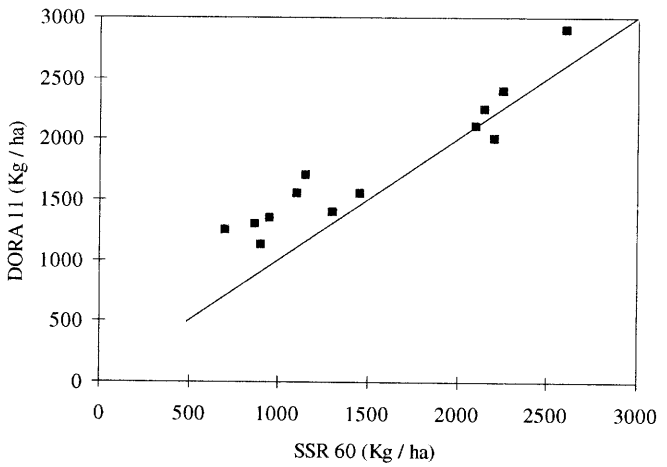

Figure 1 Seed-cotton yield performance of DORA 11 cultivar in comparison with SSR 60 (line) in 1994, 1995 and 1996 trials. ($r^2 = 0.979$)

Table 1 Average data of 13 trials collected from 1994-95 to 1996-97 crop seasons.

VARIETY	S-C (kg/ha)	EARL (%)	LINT (kg/ha)	GOT (%)	UHML (mm)	STR (g/tex)	MAT (%)	FIN (mg/km)
DORA 11	1770 a	68.3 a	681 a	38.5 a	28.5 a	27.3 a	72.2 a	219
SSR 60	1513 b	52.6 b	580 b	38.0 b	29.4 b	29.1 b	75.0 b	220
Avg. of trials	1642	60.4	630	38.2	28.9	28.2	73.6	219
C.V. (%)	9.2	8.0	8.4	1.6	1.7	2.8	3.1	4.4
Sign. Prob.	0.01	0.01	0.01	0.01	0.01	0.01	0.01	NS

Table 2 Results from yarn analyses (5 trials).

VARIETY	Y. ELONG. (%)	Y. STREN. (cN/Tex)	NEPS (200%)	Y. REGUL. (%)
DORA 11	5.3	12.5 a	626	17.6
SSR 60	5.2	13.6 b	707	17.6
Avg. of trials	5.3	12.8	611	17.3
C.V. (%)	5.5	4.4	12.8	3.3
Sign. Prob.	NS	0.05	NS	NS

obvious (Figure 1). Its bract is frego and its leaf is twisted by a pleiotropic effect of frego bract. These traits should provide better light and, in case of spraying, chemical penetration inside the canopy. Smooth leaf and susceptibility to leaf roll disease remain its major disadvantages due to SSR 60's genetic background. Results from station and multilocation tests showed a common level of fiber quality. Spinning test confirms the DORA 11's lower strength of fiber related to SSR 60.

DORA 21:

Glandless character was brought to provide a suitable free gossypol variety for Thailand. Glandless varieties originated from Africa were introduced in 1991 but appeared largely susceptible to physiological shedding on fruiting organs (Trebuil *et al.*, 1992; Sayampol *et al.*, 1993) while in the same time, several studies on animal feeding with free gossypol kernel confirm the economic interest of such varieties (Thabthipwon and Thai-Tungchin, 1996). Transfering glandless character into a local variety (SSR 60) seemed to be the fastest way for releasing a suitable gossypol free genotype. DORA 21 was created in 1994-95, multiplied during 1995-96 dry season and tested at Suwan Research and Training Station and in Lopburi area during 1996-97 crop-season (Table 3). These tests confirm that DORA 21 is adapted to the ecological and agronomic environment of Thailand with similar fiber quality to SSR 60. DORA 21 enables to provide farmers with a suitable

Table 3 Average of 1996-97 results (2 trials).

VARIETY	S-C (kg/ha)	EARL (%)	LINT (kg/ha)	GOT (%)	UHML (mm)	STR (g/tex)	MAT (%)	FIN (mg/km)
Suwan								
DORA 21	1059 a	55.3	411 a	38.2 a	30.8 a	28.9 a	73.0 A	218 a
CA413	612 b	47.2	261 b	42.5 b	32.2 b	31.8 b	83.0 b	187 b
Avg. of trails	1141	59.9	441	39.8	30.4	28.1	72.8	219
C.V. (%)	12.6	9.5	14.0	2.6	1.8	3.3	4.0	4.4
Sign. Prob.	0.01	N.S.	0.01	0.01	0.01	0.01	0.01	0.01
Lopburi								
DORA 21	1020 a	66.7	381	37.4	28.8	28.7	81.1	202
CA413	229 b	42.8	93	40.5	29.5	34.7	87.3	182
Avg. of trails	697	58.8						
C.V. (%)	16.6	14.0						
Sign. Prob.	0.01	NS						

glandless variety. Further experimentation, with SSR 60 as check, deserves to be carried out.

DORA 31:

Okra-leaf and frego bract characters are assumed to contribute in increasing the efficiency of spray (better penetration of chemicals inside the canopy), in enhancing boll maturation and in avoiding boll-rot development in case of late rainfall. This assumption is at the origin of the creation of DORA 31. The first on-station test (1996-97) seemed to confirm a better earliness of DORA 31. Compared to SSR 60, DORA 31 shows additional improvements: ginning-out-turn (+0.5%), length (+1 mm), strength (+1 g/tex), and maturity (Table 4).

DORA 41:

Brown lint character has been transferred from an American germplasm and back-crossed on SSR 60. Currently, the interest of coloured lint is based on its trade value, three times higher than that of white lint. According to the 1996-97 results, this character remains relate to a lot of other low agronomic and technological traits (Table 5).

DISCUSSION AND CONCLUSION

At the present time, among the advanced material created by the project, DORA 11 should represent the most serious alternative to cover large cotton area in Thailand. The release of DORA 11 may improve significantly seed-cotton yield in farmer's conditions due to its earliness and its rusticty. The yield potential of DORA 11 is higher than SSR 60. DORA 11, like its patent SSR 60, has smooth leaves, this character confers a high susceptibility of jassids. However, such glabrous

Table 4 1996-97 on-station results (1 trial).

VARIETY	S-C (kg/ha)	EARL (%)	LINT (kg/ha)	GOT (%)	UHML (mm)	STR (g/tex)	MAT (%)	FIN (mg/km)
DORA 31	864	65.8 a	323	37.4	30.9 a	29.0	73.6	236
SSR 60	865	51.1 b	257	36.9	29.8	28.9	69.7	241
Avg. of trails	988	55.8	349	36.8	30.5	28.7	72.8	231
C.V. (%)	16.4	7.6	15.4	2.0	1.9	3.0	3.3	4.2
Sign. Prob.	NS	0.01	NS	0.05	NS	NS	NS	NS

Table 5 1996-97 on-station results (1 trial).

VARIETY	S-C (kg/ha)	EARL (%)	LINT (kg/ha)	GOT (%)	UHML (mm)	STR (g/tex)	MAT (%)	FIN (mg/km)
DORA 41	977 a	64.2	205 a	20.9 a	20.6 a	1707	69.2	257
SSR 60	1333 b	68.7	503 b	37.7 b	29.7 b	27.1	67.8	234
Avg. of trails	995	60.8	217	20.0	22.9			
C.V. (%)	13.6	11.9	17.1	6.3	27.1			
Sign. Prob.	0.01	NS	0.01	0.01	0.01			

varieties may be suitable when using systemic insecticide seed treatment (i.e. imidachlopride) to avoid leaf roll disease and sucking pest damages at the early growth stage (Genay *et al.*, 1993). For fiber quality, DORA 11 could deserve to be improved, especially on length and strength.

DORA 31, the new okra-leaf and frego-bract cultivar, seems to have assets to compete against SSR 60. According to the first data recorded in 1996-97, DORA 31 appears to be better than SSR 60 for earliness and fiber quality. These results must be tested and repeated by more experimentations before releasing.

For glandless germplasms, releasing such variety has to be managed with a seed production organization strategy. DORA 21 tends to give high seed-cotton yield under Thai environment regarding its first results. The main problem pertaining to the use of this variety will be seed mixing up and genetic impurity risk. After confirmation of these results, particular organizations for seed multiplication (isolated area of glandless cotton fields, special cares all along the multiplication processes from sowing to harvesting) and for seed processing (ginning, seed production) should be carried out aiming at ensuring the maximum rate of purity. Without genetic purity, glandless genotypes lose their interest as seeds and could not longer be used neither for animal feeding nor human food. The glandless germplasm development would demand a suitable production management in a homogenous area of farmers, all involved in

cropping this kind of cotton.

Coloured lint variety cultivation requires the same observations for seed multiplication. By the time being, DORA 41, with poor agronomic and technological characteristics, could only be proposed if the coloured fiber price of the national or international market may compensate the loss due to its low yield potential.

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