

# Inheritance of Aroma in Two Rice Cultivars

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## Resumé

Dartey, P. K. A., Asante, M. D. & Akromah, R. *Héritage d'Arome dans deux genres du riz.* L'arome en graine du riz parfumé augmente l'approbation de la clientèle et la valeur du marché. Différents auteurs ont rapporté l'arome d'être sous différents contrôles génétiques. La Connaissance des contrôles d'arome dans les variétés aromatiques permet aux producteurs de choisir les stratégies appropriées de la sélection pour incorporer l'arome en variété non-aromatique du rendement élevé. Les différents croisements étaient entamés pour étudier l'héritage d'arome dans NERICA1 et JASMINE85 et puis déterminer le lien allelomorphe entre les deux variétés. La présence ou l'absence d'arome était considérée en fleurant 1 g des herbes coupées qui étaient mises dans 5ml de 20g l<sup>-1</sup> KOH un rétrocroisement (W A B 450 - 5-1-BL1-DV6/JASMINE85//JASMINE85) rapport de 1:1 aromatique: Les herbes non-aromatiques ont confirmé un rapport ancien que l'arôme en JASMINE85 est contrôlé par un gène unique. Un gène unique contrôle également l'arome dans NERICA 1 (aromatique:non-aromatique f<sub>2</sub> et rapport du rétrocroisement de 1:3 et 1:1 respectivement. Le gène pour l'arome dans NERICA1 est allétique à celui dans JASMINE85 puisque le f<sub>1</sub> de NERICA1/JASMINE85 ainsi que leurs réciproques sont aromatiques.

**Mots clés:** Le riz, l'héritage, l'arome, NERICA1, JASMINE85.

## Abstract

Aroma in scented rice grain increases consumer acceptance and market value. Different authors have reported aroma to be under various genetic control. Knowledge of the genetic control of aroma in aromatic varieties enables breeders to choose appropriate breeding strategies to incorporate aroma into high yielding non-aromatic varieties. Various crosses were made to study the inheritance of aroma in NERICA1 and JASMINE85 and determine the allelic relationship between the two varieties. The presence or absence of aroma was assessed by smelling 1g of cut leaves that were put into 5 ml of 20g l<sup>-1</sup> KOH. A backcross (WAB450-5-1-BL1-DV6/JASMINE85//JASMINE85) ratio of 1:1 aromatic: non-aromatic plants confirmed an earlier report that aroma in JASMINE85 is controlled by a single gene. A single gene also controls aroma in NERICA1 (aromatic: non-aromatic F<sub>2</sub> and backcross ratios of 1:3 and 1:1 respectively). The gene for aroma in NERICA1 is allelic to that in JASMINE85 since the F<sub>1</sub> of NERICA1/JASMINE85 as well as their reciprocals are aromatic.

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**Keywords:** Rice, inheritance, aroma, NERICA1, JASMINE85.

## **Introduction**

The most notable characteristic of the most preferred and expensive rice brands in Ghana is aroma (perfume or scent) (Asante, 2004; MoFA, 1999 & 2000). This is reflected in the higher prices they are sold for on the local market.

Aroma in rice is attributed to 2-acetyl-1-pyrroline, which is present in all rice, but in significantly greater concentrations in aromatic cultivars (Buttery *et al.*, 1983; 1986). A review of literature reveals that the numbers of genes that control aroma in rice vary depending on the variety used, and has been reported to be by two recessive genes (Geetha, 1994; Pinson, 1994; Dong *et al.*, 2001a); one recessive gene (Berner and Hoff, 1986; Dong *et al.*, 1992; Pinson, 1994; Dong *et al.*, 2001a; Dong *et al.*, 2001b); one dominant gene (Kadam and Patankar, 1938 cited by Pinson, 1994); two dominant genes (Tripathi and Rao, 1979); three complimentary recessive genes (Reddy and Sathyanarayanaiah, 1980); four complimentary recessive genes (Dhulappanavar, 1976) and a single recessive gene interacting with an inhibitor gene (Tsuzuki and Shimokawa, 1990). Lorieux *et al.* (1996) identified a major gene and two quantitative trait loci (QTL) that controlled aroma. Pinson (1994) reported aroma in JASMINE85 to be controlled by a single recessive gene.

NERICA1 (WAB450-I-B-P38-HB) is an interspecific hybrid between WAB56-104 (*Oryza sativa*) and CG14 (*O. glaberrima*) both of which are inbred and non-aromatic. Genetic control of aroma in NERICA1 has not been previously reported.

In the present study, NERICA1 and JASMINE85 were used as donors in an attempt to incorporate aroma into IDSA85 and WAB450-5-1-BL1-DV6 to improve their marketability. Studying the inheritance of aroma in these aromatic varieties will help to choose the most appropriate breeding strategy for incorporating the aroma genes into non-aromatic varieties. The specific objectives of this study were to determine the number of aroma gene(s) in NERICA1, validate if a single gene controls aroma in JASMINE85 and to determine the allelism between aroma genes in the two varieties.

## **Materials and methods**

The study was conducted in pots at the experimental site of the Crops Research Institute at Kwadaso from October 2002 to December, 2003. Rice cultivars used for the experiment were IDSA85 and WAB450-5-1-BL1-DV6 which are non-aromatic and WAB 450-I-B-P-38-HB (NERICA1) and JASMINE85 which are aromatic. Healthy and uniform seeds of the three varieties were sown; sowing was staggered over a two-week period to

synchronize flowering. The crosses made and numbers of individuals evaluated are as in Table 1. Plants were taken care of under standard agronomic practices including watering and scaring of birds to eliminate bird damage.

Aroma was detected after Sood and Siddiq (1978) as follows: About 1g cut leaves were put into 5 ml of 20 g<sup>-1</sup> KOH contained in a capped vial and stored at room temperature for 15 minutes. Vials were thereafter opened and smelled for aroma, using the parents as blind controls. Three persons able to accurately detect aroma from the blinds were used as panelists. To prevent overwhelming the senses of panelists, not more than twenty samples were evaluated at a time.

Aroma scores were averaged over all panel members. Observed F<sub>2</sub> and backcross segregation ratios for aromatic or non aromatic phenotypes were compared to various genetic ratios.

The agreement or otherwise of these ratios were tested by means of chi-square test.

### Results and Discussion

F<sub>1</sub> of IDSA85/NERICA1 and WAB450-5-1-BL1-DV6 (DV6)/JASMINE85 were not aromatic, suggesting that recessive gene(s) controls aroma in both NERICA1 and JASMINE85. Pinson (1994) reported aroma in JASMINE85 to be controlled by a single recessive gene. This was confirmed by a backcross (DV6/JASMINE85//JASMINE85) ratio of 108 aromatic: 92 non-aromatic plants fitting into a 1:1 ratio ( $\chi^2 = 1.13$ , P = 0.29) (Table 2).

F<sub>2</sub> of IDSA85/NERICA1 segregated into 91 aromatic: 231 non-aromatic plants which fit into a 1:3 ratio ( $\chi^2 = 1.66$ , P = 0.20) (Table 2). This indicates that a single recessive gene controls aroma in NERICA1. A backcross ratio of 41

**Table 1. Crosses made and number of individuals used in the study.**

<i>Cross</i>	<i>Number of individuals</i>
F <sub>1</sub> IDSA85/NERICA1	10
F <sub>1</sub> NERICA1/JASMINE85	10
F <sub>1</sub> WAB450-5-1-BL1-DV6/JASMINE85	10
F <sub>2</sub> IDSA85/NERICA1	322
BC <sub>1</sub> (IDSA85/NERICA1//NERICA1)	93
BC <sub>1</sub> (WAB450-5-1-BL1-DV6/JASMINE85//JASMINE85)	200

**Table 2. Segregation of aroma in the various rice crosses made.**

Cross	Aromatic	Non-aromatic	Ratio	$\chi^2$	P
F <sub>1</sub> IDSA85/NERICA1	0	10			
F <sub>1</sub> NERICA1/JASMINE85	10	0			
F <sub>1</sub> JASMINE85/NERICA1	10	0			
F <sub>1</sub> WAB450-5-1-BL1-DV6/JASMINE85	0	10			
F <sub>2</sub> IDSA85/NERICA1	91	231	1:3	1.66	0.20
BC <sub>1</sub> (IDSA85/NERICA1//NERICA1)	41	52	1:1	1.08	0.30
BC <sub>1</sub> (WAB450-5-1-BL1-DV6 /JASMINE85//JASMINE85)	108	92	1:1	1.13	0.29

aromatic: 52 non-aromatic plants, indicating a 1:1 ratio with  $\chi^2 = 1.08$ , P= 0.30 (Table 2), confirmed that aroma in NERICA1 is controlled by a single recessive gene.

F<sub>1</sub> of NERICA1/JASMINE85 and its reciprocals were all aromatic, indicating that the aroma gene in NERICA1 is allelic to that in JASMINE85.

### Conclusion

The results of study indicated that

NERICA1 and JASMINE85 each contain a single gene for aroma, and these two single genes are allelic.

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