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PJBS

ISSN 1028-8880

# Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 10 (1): 142-144, 2007
ISSN 1028-8880


# Agronomic and Quality Characteristics of High-Yielding Rice Lines

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**Abstract:** This study is a part of rice cultivar development program in north of Iran with the aim of yield potential increase and attention to eating quality. Thirteen lines developed from the crosses between high yielding cultivars with aromatic low yield ones based on pedigree breeding method. These lines along with two controls (Neda and Sang-e-Tarom) were evaluated for agronomic and quality traits in a randomized complete block design during 2005. Farm and laboratory tests showed that lines 33-DN-1, 33-DN-18 and 32-DN-6 were superior in yield (more than 5.5 t $ha^{-1}$) and had suitable eating quality in comparison with Sang-e-tarom as a local control.

**Key words:** Rice, high-yield lines, agronomic and quality characters, Iran

## INTRODUCTION

Rice is the staple food in Iran. Its cooking and eating quality is very important for Iranian consumers. Despite of low yield (averaging 2.5 to 4 t $ha^{-1}$), more than 70% of the total rice area is allocated for cultivation of local high quality varieties, which are the same as the Basmati type (Nematzadeh and Khush, 1993). These varieties are tall, susceptible to lodging, long grains, slender shape, intermediate amylose content and gelatinization temperature, soft gel consistency, good grain elongation and scent and susceptible to blast and stem borer (Shobha Rani, 1998; Singh *et al*., 2000). Efforts have been done to improve the yield of local varieties or to change the quality of improved varieties in Rice Research Centers in Iran. Some varieties such as Sadri, Firuz, Mehr, Binam, Zayanderood and Churam1 are achievements of pure line selection programs.

The national breeding program in Iran depends mainly on pedigree breeding method for cultivar development. Efforts is focused on development of varieties with high yield potential and acceptable quality through hybridizing of local aromatic with high yielding foreign cultivars. In this regard several cultivars released in Iran such as Neda and Nemat (Nematzadeh *et al.,* 1997).

The objective of this investigation was identification of superior lines based on important agronomic and quality traits for cultivar development in north of Iran.

## MATERIALS AND METHODS

The code name and genetic origin of breeding lines presented in Table 1. These lines derived through pedigree breeding method from crosses between high yield cultivars (Amol3 and Sepidrood) and local high-quality cultivars (Domsiah and Sang-e-Jo). Lines along with two check varieties (Neda and Sang-e-tarom) were evaluated for agronomic and quality traits in a randomized complete block design with three replications at experimental farm of Sari College of Agriculture. Neda is a commercial high yield cultivar and Sang-e-tarom is popular growing local aromatic landrace in Iran. Each plot was 6 $m^2$ with 20×20 cm planting pattern. The data on days to heading, plant height (cm), productive tiller/plant, panicle length (cm) and yield (t $ha^{-1}$) were recorded. The quality characters such as GT (gelatinization temperature) (Cagampang *et al*., 1973), GC (gel consistency) (Little *et al*., 1958) and AC (amilose percent) (Juliano and Villareal, 1993) also measured. Cultural practices followed were those considered normal for the area.

Table 1: List of studied lines with their genetic origin

| Line | Cross |
|---|---|
| 30-DN-1 | Domsiah-e-Mashhad/Amol3 |
| 30-DN-2 | Domsiah-e-Mashhad/Amol3 |
| 31-DN-B | Domsiah/Amol3 |
| 32-DN-2 | Sepidrood/Sang-e-Jo |
| 32-DN-6 | Sepidrood/Sang-e-Jo |
| 32-DN-9 | Sepidrood/Sang-e-Jo |
| 32-DN-10 | Sepidrood/Sang-e-Jo |
| 33-DN-1 | Sepidrood/Sang-e-Jo |
| 33-DN-2 | Sepidrood/Sang-e-Jo |
| 33-DN-11 | Sepidrood/Sang-e-Jo |
| 33-DN-14 | Sepidrood/Sang-e-Jo |
| 33-DN-18 | Sepidrood/Sang-e-Jo |
| 33-DN-19 | Sepidrood/Sang-e-Jo |

Data were analyzed by analysis of variance (Steel and Torrie, 1980) and mean comparisons performed by Duncan's test at 5% statistical level.

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## RESULTS AND DISCUSSION

There are high significant differences between genotypes for studied characters indicating existence of genetic variation. Mean squares of replications were reduced to be non-significant ($p>0.05$) for tiller/plant and yield, while for the other traits were significant (Table 2).

The data on days to heading was significantly affected by genotypes. The highest days to heading was observed in Neda (101 day) but was at par with 30-DN-1 (98.33 day) and 30-DN-2 (98 day). All lines derived from Sepidrood/Sang-e-Jo cross had minimum days to heading ranging from 90.67 to 94.00 days (Table 3).

The panicle length varied between 26.49 cm (33-DN-2) to 32.85 cm (30-DN-2) (Table 3). Lines derived from the crosses which Sepidrood is contributed had shorter panicle than those lines obtained from crosses which Amol3 is contributed. Lowering the panicle height could have a profound effect on increasing lodging tolerance because of the center of gravity of the shoot is reduced (Setter *et al*., 1995). Shorter height also reduces susceptibility to loading (Tsunoda, 1962). All of the lines with the height ranging from 111.61 to 124.50 cm appeared to be tolerant to the lodging and were significantly shorter than Sang-e-tarom (158.83 cm) (Table 3).

Paddy yield of various lines was significantly different (Table 3). The highest yield of 8.10 t $ha^{-1}$ was obtained from commercial high yield control (Neda). It was closely followed by 31-DN-B (6.96 t $ha^{-1}$), 33-DN-11 (6.83 t $ha^{-1}$), 33-DN-18 (6.65 t $ha^{-1}$) and 33-DN-2 (6.52 t $ha^{-1}$). All of the breeding lines produced more yield than Sang-e-tarom (3.65 t $ha^{-1}$) as local high quality control. It is obvious that not only yield performance but also number of productive tiller/plant of the breeding lines fall in the range of two control varieties (Table 3).

Laboratory evaluations for quality characters showed that the majority of lines had alkali spread value from 6 to 7, indicating low GT status in breeding lines (Table 3). Based on GC values, lines classified into medium GC (length of gel, 41 to 60 mm) or soft GC (length of gel, more than 61 mm) groups. Medium or soft GC is preferred over hard GC in almost all regions of Asia (Dela Cruz, 2002), so all of lines suitable for this trait. AC values varied between 23.0 to 26.9% and lines fall in intermediate (20-25%) or high amilose (>25%) groups (Komar and Khush, 1986). Lines 31-DN-B, 32-DN-6, 33-DN-1 and 33-DN-18 identified as intermediate-amylose rice which is the preferred type in most rice-growing areas of the world (Dela Cruz, 2002).

The visual assessment of lines was made by farmers in different growth stages and lines rated (Table 3), because it is important to ascertain the reaction of farmers as to the performance and acceptance before release of variety (Malik *et al*., 2002).

In conclusion, three lines namely 33-DN-1, 33-DN-18 and 32-DN-6 identified as superior lines based on high yield potential (more than 5.5 t $ha^{-1}$), suitable quality and phenotypic preference by farmers. It is mentioned that seed multiplication and regional test is underway for selected lines.

Table 2: Analysis of variance for agronomic and quality characteristics

| Sources of variation | Days to heading | Height | Tiller/plant | Panicle length | Yield | GT | GC | AC |
|---|---|---|---|---|---|---|---|---|
| Treatment | 36.98** | 349.18** | 84.14** | 10.79** | 3.42** | 4.32** | 770.57** | 8.76** |
| Block | 22.15** | 222.87** | 19.47$^{ns}$ | 12.26** | 0.04$^{ns}$ | 0.99* | 1344.47** | 23.22** |
| Error | 3.66 | 25.70 | 14.02 | 2.21 | 0.88 | 0.17 | 166.39 | 2.75 |

ns, * and ** is not significant, significant and high significant, respectively

Table 3: Mean performance of lines for different characteristics

| Lines | Days to heading (day) | Plant height (cm) | Tiller/ plant (No.) | Panicle length (cm) | Yield (t $ha^{-1}$) | GT | GC (mm) | AC (%) | Farmer rating |
|---|---|---|---|---|---|---|---|---|---|
| 30-DN-1 | 98.33ab | 116.22bcd | 19.22bc | 30.91abc | 4.94de | 4.23c | 92a | 23.7a | |
| 30-DN-2 | 98.00ab | 118.61bcd | 18.45bc | 32.85a | 6.27bcd | 3.93c | 97a | 24.1a | |
| 31-DN-B | 96.33bc | 116.56bcd | 15.67bc | 31.80ab | 6.96abc | 4.10c | 100a | 25.0a | Good |
| 32-DN-2 | 91.33e | 117.23bcd | 15.33bc | 30.53abcd | 5.21cde | 6.70a | 95a | 26.9a | Good |
| 32-DN-6 | 93.00cde | 118.72bcd | 15.00c | 28.74cdef | 5.89bcd | 6.77a | 58b | 23.5b | Good |
| 32-DN-9 | 91.33e | 123.17bc | 16.56bc | 28.59cdef | 6.12bcd | 7.00a | 92a | 25.9a | Good |
| 32-DN-10 | 94.00cde | 123.17bc | 17.00bc | 28.45cdef | 5.38cd | 6.85a | 41b | 26.1a | Good |
| 33-DN-1 | 92.67de | 123.11bc | 21.89bc | 27.78def | 5.93bcd | 6.91a | 89a | 23.4b | Best |
| 33-DN-2 | 91.33e | 111.61d | 22.11bc | 26.49f | 6.52abcd | 6.93a | 90a | 25.6a | Best |
| 33-DN-11 | 91.33e | 120.61bcd | 17.78bc | 27.78def | 6.83abc | 7.00a | 95a | 26.0a | Best |
| 33-DN-14 | 90.67e | 120.11bcd | 18.78bc | 26.72ef | 6.01bcd | 6.40a | 91a | 26.8a | Best |
| 33-DN-18 | 91.33e | 118.72bcd | 17.89bc | 26.94ef | 6.65abcd | 6.86a | 96a | 23.0b | Best |
| 33-DN-19 | 92.67de | 124.50b | 20.00bc | 28.53cdef | 5.75cd | 7.00a | 97a | 25.3a | Best |
| Neda | 101.00a | 112.67d | 22.67b | 26.78ef | 8.10a | 5.00b | 85.1a | 26.9a | |
| Sang-e-tarom | 95.33bcd | 158.83a | 14.89c | 29.49bcde | 3.65e | 5.00b | 96.8a | 20.3c | |

Lines with the same letter refer to non-significant at 5% statistical level

**ACKNOWLEDGMENTS**

This research conducted by financial support of Mazandaran University. We are grateful to Mr. M. Oladi and Mrs. Tavassoli, Fathi and Ali-nejad for their assistance.

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