NEW AROMATIC RICE (ORYZA SATIVA L.) VARIETY TJP 48 FOR UPLAND RAINFED CULTIVATION

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INTRODUCTION

Rice ecosystems are generally classified into 4 types: irrigated, rainfed lowland, deep-water and rainfed upland. Rainfed upland rice is grown in unbunded fields where good soil drainage and/or uneven land surface renders the accumulation of water impossible (Khush, 1997). Upland rice is usually grown in systems where little or no fertilizer is applied, and is direct-seeded into unpuddled, unsaturated soil (Atlin, et al., 2004). Most traditional upland rice varieties are low-yielding and prone to lodging, but are adapted to non-flooded soils (Atlin, et al., 2009). Upland rice is generally the lowest yielding ecosystem. Abiotic stress is a major constraint to rice production in water-limited environments, the need to improve drought adaptation of rice is becoming increasingly important (O'Toole, 2004).

India ranks first in area with about 44.0 m. ha. under rice with annual production of 143 million tones. In Maharashtra Rice is the second important crop next to Sorghum. Rice area is concentrated in Vidarbha, Konkan, and Western Maharashtra. The total area in the state is 15.46 lakh ha. with the average productivity of 2.65 tones/ha. In Marathwada region of Maharashtra rice is cultivated in all districts as rainfed upland and irrigated upland on more or less area. Average productivity of rice in this region is lowest i.e. 770 kg/ha.

The average productivity is less than Maharashtra due to scanty and erratic rainfall with long dry spells. Moreover, semi dwarf varieties grown in wet land paddy areas of Maharashtra shows chlorotic symptoms caused by iron deficiency under upland situation (Pande, 1977). Hence, these varieties are not preferred by farmers because of their poor paddy yields.

Quality desired in rice vary from one geographical region to another and consumers demand certain varieties and favours specific quality traits of milled rice for home cooking (Azeez and Shafi, 1966). However, in indica rice consuming countries, long grain with intermediate gelatinization temperature is preferred since it becomes soft and fluffy after cooking (Hossain et al., 2009). The physiochemical characteristics include kernel length, kernel breadth, L/B ratio, kernel size and shape: and cooking quality include alkali digestion value, gelatinization temperature and elongation ratio are important for judging the quality and performance of rice from one group of consumers to another (Selappan et al., 2009).

A new variety which is drought tolerant, non- lodging (semi dwarf), tolerant to iron chlorosis, early duration, non-shattering and also having a desirable grain quality is the prime need of upland rainfed areas of this region. Considering the requirements, effort were made by undertaking hybridization programme (Terna X TJP 28) followed by pedigree method of selection, which has resulted in the

ABSTRACT

Average productivity of rice in Marathwada region of Maharashtra is lowest i.e. 770 kg/ha. The average productivity is less than Maharashtra due to scanty and erratic rainfall with long dry spells. Moreover, semi dwarf varieties grown in wet land paddy areas of Maharashtra shows chlorotic symptoms caused by iron deficiency under upland situation. Hence, new variety which is drought tolerant, non- lodging (semi dwarf), tolerant to iron chlorosis, early duration, non-shattering and also having a pleasant aroma is the prime need of upland rainfed areas of this region. The variety TJP 48 was developed by hybridization (Terna X TJP 28) followed by pedigree method of selection and released for general cultivation in Marathwada region of Maharashtra in 2013. It recorded 21.6% yield advantage against the check Terna. TJP 48 is drought tolerant, early maturing, aromatic, semi dwarf and high yielding with tolerance to iron chlorosis and blast disease.

KEY WORDS

Upland rainfed rice
Early
Semidwarf
Aromatic, Iron chlorosis

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development of rice variety TJP 48, released for general
cultivation in Marathwada region of Maharashtra in 2013. It
has recorded 21.6% yield advantage against the local check
Terna. TJP 48 is drought tolerant, early maturing, aromatic
having desirable grain quality, semi dwarf and high yielding
with tolerance to iron chlorosis and blast disease.

MATERIALS AND METHODS
In 1989, a tall rice variety Terna was released from Agriculture
Research Station, Tuljapur, Vasantrao Naik Marathwada Krishi
Vidyapeeth, Parbhani for upland rainfed areas of Marathwada
region. Terna was ideal variety for upland rainfed region,
however disliked by the farmers because of its lodging habit
which makes it difficult to harvest and causes a considerable
losses in yield. Moreover grain shattering problem was also
severe. Accordingly, at Agriculture Research Station, Tuljapur,
the efforts were made to develop a new variety which is non-
lodging (semi dwarf), tolerant to iron chlorosis, early duration,
drought tolerant, non-shattering and also having a pleasant
aroma. The crossing programme was initiated in 1998 by
taking terna as female parent which is tall, lodging, shattering,
and non aromatic and TJP 28, Heera and some IET entries as
male parent. Male parent TJP 28 was short stature, having
pleasant aroma and non shattering habit. The culture TJP 48
was developed and by hybridization (Terna x TJP 28) followed
by pedigree method of selection. It was released for cultivation
in Marathwada region of Maharashtra in 2012. (Joint Agresco
Report of Maharashtra, May 2012 and State Seed Sub-
Committee Meeting, 2013)

Important quality parameters of rice genotypes are mainly taken
in to consideration while its release as a variety. Therefore the
quality parameters of TJP 48 were analyzed at well equipped
and standard laboratories situated at Regional Agricultural
Research Station, Karjat, Dist. Raigad and Directorate of Rice
Research, Hyderabad during 2010 to 2012.

In field iron deficiency chlorosis symptoms are usually
apparent 15-20 days after sowing. Therefore, observations
were recorded twice during the crop growth i.e 20 and 40
days after sowing. Average of the two counts were taken for
computations (Deosarkar, 1984). Scores for the reaction of
disease and pests were recorded as per Standard Evaluation
System for Rice (SES), IRRI and November, 2002.

RESULTS AND DISCUSSION
Upland rice is generally more prone to drought than lowland
rice because there is no field accumulation of water in this
system, due to the lack of a bund or hard-pan layer, and,
often, due to unlevel, sloping topography (Fukai and Cooper,
1995 and Babu, et al., 2001). Abiotic stress is therefore a
major constraint to rice production in water-limited
environments. In this region, the onset of the rainy season is
generally in June, and withdrawal can occur as early as late
September. There are 3 major breeding targets that may result
in improved grain yield under drought: increasing yield
potential per se, timing flowering with periods when water is
available and improving drought resistance. (Mackill et al.,
2003). Selection for yield potential is therefore an important
element in developing varieties that produce acceptable yields

<table>
<thead>
<tr>
<th>Designation</th>
<th>Location</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>Mean</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>TJP 48</td>
<td>Tuljapur</td>
<td>AMB</td>
<td>SOM</td>
<td>TJP</td>
<td>AMB</td>
<td>SOM</td>
<td>TJP</td>
<td>AMB</td>
<td>SOM</td>
</tr>
<tr>
<td>Terna (Ch)</td>
<td>2561</td>
<td>2589</td>
<td>2578</td>
<td>2112</td>
<td>1926</td>
<td>2493</td>
<td>2544</td>
<td>2459</td>
<td>2438</td>
</tr>
<tr>
<td>Terna (Ch)</td>
<td>1501</td>
<td>1483</td>
<td>1512</td>
<td>1432</td>
<td>1483</td>
<td>1432</td>
<td>1483</td>
<td>1432</td>
<td>1512</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>447</td>
<td>325</td>
<td>254</td>
<td>235</td>
<td>241</td>
<td>161</td>
<td>219</td>
<td>199</td>
<td>171</td>
</tr>
<tr>
<td>CV%</td>
<td>7.7</td>
<td>7.7</td>
<td>7.7</td>
<td>7.7</td>
<td>7.7</td>
<td>7.7</td>
<td>7.7</td>
<td>7.7</td>
<td>7.7</td>
</tr>
</tbody>
</table>
NEW AROMATIC RICE

The culture TJP 48 was evaluated along with checks under direct seeded condition in upland rainfed (Black soil) areas of Marathwada region in Maharashtra State Coordinated trials during kharif 2008 to 2011. The data are presented in Table 1 and 2. During four years of testing, on pooled basis, TJP 48 recorded 21.6% yield advantage against the check Terna. Direct selection for yield under stress has been shown to result in significant gains in upland rice stress tolerance. Data related to characters associated with grain yield are presented in the Table 2. It revealed that TJP 48 is early maturing (82 DFF) thus fitted well in multiple cropping sequences in command areas of Marathwada region, having medium bold grains with 24.46 g test weight and 101 spikelets per panicle. Moreover it has semi dwarf (82 cm plant height) and strong culm which prevents its lodging even after maturity.

According to Singh (2013a) and Singh, (2013b) days to 50% flowering and total number of grains per panicle had significant association with grain yield. Moreover Sarawgi (2014) revealed that the characters viz., number of effective tillers per plant, balancing plant height, optimum L/B ratio and higher 100 seed weight contribute more towards grain yield. Iron chlorosis occurs frequently in calcarious soils and more so in drought prone areas. Under rainfed upland conditions rice crop suffers from iron deficiency during seedling stage due to aerobic conditions which favors the oxidation of Fe$^{2+}$.

<table>
<thead>
<tr>
<th>Varieties</th>
<th>50% FLR</th>
<th>Height cm.</th>
<th>No. of panicles/m²</th>
<th>No. of spikelets/ panicle</th>
<th>Test weight, Gms.</th>
<th>Grain type</th>
<th>White belly</th>
<th>Yield kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>TJP 48</td>
<td>82.33</td>
<td>79</td>
<td>283.6</td>
<td>101</td>
<td>24.46</td>
<td>LB</td>
<td>A</td>
<td>2442</td>
</tr>
<tr>
<td>Terna (Ch)</td>
<td>81.66</td>
<td>104.5</td>
<td>234.3</td>
<td>100.6</td>
<td>24.26</td>
<td>LS</td>
<td>A</td>
<td>2033</td>
</tr>
</tbody>
</table>

Table 3: Quality parameters of the variety TJP 48

<table>
<thead>
<tr>
<th>Designation</th>
<th>Grain type</th>
<th>Grain chalk</th>
<th>WU (mL)</th>
<th>VER</th>
<th>KLAC</th>
<th>ER</th>
<th>Aroma ASV</th>
<th>AC % (20-25)</th>
<th>GC (69-74ºC)</th>
<th>GT</th>
<th>Protein content (%)</th>
<th>Mill HRR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TJP 48</td>
<td>LB</td>
<td>A</td>
<td>285</td>
<td>4.25</td>
<td>12.9</td>
<td>1.84</td>
<td>MS</td>
<td>5.0</td>
<td>23.26</td>
<td>46</td>
<td>High -intermediate</td>
<td>8.0</td>
</tr>
<tr>
<td>Terna (Ch)</td>
<td>LS</td>
<td>A</td>
<td>305</td>
<td>4.37</td>
<td>13.5</td>
<td>1.97</td>
<td>NS</td>
<td>3.5</td>
<td>24.53</td>
<td>84</td>
<td>High &gt; 74ºc</td>
<td>7.6</td>
</tr>
</tbody>
</table>

Table 4: Distribution of Rice varieties in different iron chlorosis grades* (Kharif 2011)

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Cultivars</th>
<th>Iron chlorosis reaction</th>
<th>Mean grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tolerent</td>
<td>Sensitive</td>
</tr>
<tr>
<td>TJP 48</td>
<td>221</td>
<td>29</td>
<td>-</td>
</tr>
<tr>
<td>Parag</td>
<td>215</td>
<td>35</td>
<td>-</td>
</tr>
<tr>
<td>Terna</td>
<td>216</td>
<td>33.5</td>
<td>-</td>
</tr>
<tr>
<td>Mean</td>
<td>217.3</td>
<td>32.5</td>
<td>-</td>
</tr>
<tr>
<td>Pusa basmati 1</td>
<td>-</td>
<td>13</td>
<td>-</td>
</tr>
<tr>
<td>Basmati 370</td>
<td>12.5</td>
<td>38.5</td>
<td>97.5</td>
</tr>
<tr>
<td>Mean</td>
<td>6.25</td>
<td>25.75</td>
<td>95.5</td>
</tr>
</tbody>
</table>

Iron chlorosis grades: 0 and 1: Tolerent; 2,3 and 4: Sensitive; *Average over two counts made at 20 and 40 days after seeding

Table 5: Performance of TJP 48 under adoptive trials conducted on farmers field during Kharif 2011 (Total 21 trials).

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Districts (Maharashtra)</th>
<th>No. of adaptive trials</th>
<th>Yield kg/ha.</th>
<th>% increase over check</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TJP 48 (Prasad)</td>
<td>Terna</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Latur</td>
<td>5</td>
<td>1974</td>
<td>1578</td>
</tr>
<tr>
<td>2</td>
<td>Osmanabad</td>
<td>4</td>
<td>1855</td>
<td>1665</td>
</tr>
<tr>
<td>3</td>
<td>Beed</td>
<td>3</td>
<td>2210</td>
<td>1850</td>
</tr>
<tr>
<td>4</td>
<td>Hingoli</td>
<td>5</td>
<td>2105</td>
<td>1808</td>
</tr>
<tr>
<td>5</td>
<td>Parbhani</td>
<td>4</td>
<td>2120</td>
<td>1845</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>21</td>
<td>2044</td>
<td>1741</td>
</tr>
</tbody>
</table>

Table 6: Reaction of the variety TJP 48 to Disease and pest.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Reaction to leaf blast</th>
<th>Reaction to stem borer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuljapur</td>
<td>2010</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2011</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Parbhani</td>
<td>2011</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
to Fe$^{3+}$. This ferric form precipitate and gets deposited on the roots surface as ferric oxide and ferric hydroxides and prevents the entry of soluble ferrous iron into the root system. As a result crop suffers from iron deficiency and exhibits chlorosis in young leaves. Such a deficiency is more common in calcareous and alkaline soils than in acid or neutral soils. Table 4 illustrates the distribution of rice varieties in different iron chlorosis grades. Most of the plants of TJP 48, Terna and Parag were in 0 grade of the tolerant class. The mean iron chlorosis grade of the tolerant genotypes were 0.12 while that of the sensitive genotypes were 2.51. The mean iron chlorosis grade of TJP 48 was 0.12. Therefore the variety TJP 48 was classified under tolerant category when evaluated on black calcareous soils under upland rainfed conditions of Tuljapur (MS) during khairil 2011.

Quality parameters of TJP 48 are presented in table 3. Quality rice varieties are notable by high market price. These varieties receive more attention in the niche markets such as aromatic rice, low amylose rice (for diabetes). Among quality attributes of milled rice such as amylose content (AC), gelatinization temperature, gelatinize consistency, kernel length and breadth, shape, size, endosperm, kernel color and kernel elongation, aromatic attribute receives much attention.

Intermediate amylose content (23.26%) and intermediate gelatinization temperature of new variety TJP 48 indicate superior grain quality as amylose content and GT strongly influences the cooking and eating characteristics of rice. Rice with a intermediate amylose content (20-25%) tends to be softer and fluffy on cooking. Amylose is also responsible for the way that rice hardens on cooling.

It has translucent and mildly scented grains. Translucent grains do not break during milling. Breakage of grain during milling reduces the percentage of whole grain/ head rice and it can be due to a number of factors. Head rice yield is often the most important quality parameter to millers since the head rice yield is generally linked to the payment they receive (http://www.betuco.be/rijst/Rice%20Quality.pdf). The rice variety TJP 48 is having 72.2% milling percentage and 69.5% head rice recovery (HRR) ensures high yield in term of whole rice grains which is of market value.

Total 21 Adoptive trials were conducted on farmers field in 5 districts of Marathwada region in 2011. TJP 48 exhibited 17.4% more grain yield than check Terna (Table 5). Considering the grain yield advantage, morphological characteristics viz., semidwarf stature contributing lodging tolerance, earliness and desirable quality parameters (intermediate AC percentage and mild aroma), TJP 48 has been recommended for cultivation on black soils in upland rainfed areas of Marathwada region of Maharashtra state in 2013.

**REFERENCES**


Joint Agresco Report of Maharashtra held at Dr. P.D.K.V., Akola (MS), May 2012 page no. 7


