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# CO(R) 50 (IET 19321): A New Plant Type High Yielding Medium Duration Rice Variety for Irrigated Ecosystem

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**Department of Rice, Tamil Nadu Agricultural University, Coimbatore developed CO(R) 50 medium duration rice variety, which was found promising for cultivation in irrigated zones of Southern states of India. CO(R) 50 rice variety has new plant type characters for high yield performance which can give mean grain yield of 6338 kg/ha. It is a derivative of the cross between CO 43 and ADT 38 which matures in 130-135 days. The variety was tested in station trial for four years (2001-2004), Multi Location Trial for two years (2005-06 and 2006-07), Adaptive Research Trial (2006-07) and in AICRIP trial for three years (2005-07). Based on the consistent performance in AICRIP trial, the variety was released by Central Variety Release committee during 2009. Front line demonstrations were conducted for the past three years (2011-14) which showed that variety has high yield potential in Tamil Nadu. CO (R) 50 variety is moderately resistant to stem borer, leaf folder and gall midge pests and blast, sheath blight, brown spot, rice tungro disease (RTD) and bacterial leaf blight (BLB) diseases. It produces medium slender white rice with intermediate amylose (24.0%) content, soft gel consistency and moderate gelatinization temperature. Variety is able to give good quality cooked rice and also found suitable for making famous south Indian breakfast 'idly'.**

**Key words:** CO(R) 50, Medium duration rice variety, New plant type

Rice is one of the most important staple food crops and it provides more than 40 per cent of the daily calories for the world population (Parengam et al., 2010). In the year 2013-2014, total rice production in India was 106.54 million tonnes from an area of 43.95 million hectares with the mean productivity of 2.42 tonnes/ha (Agricultural Statistics at a glance, 2014). To meet the requirement of growing population and changing life style, demand for foodgrain production can be met by maintaining the increasing trend in food production steady. This has necessarily to come from increase in productivity under decreasing trend of land availability and total factor productivity and has to meet the demands for sustainability and preservation of environmental quality. Rice research has to be geared up to surmount the technological challenges in breaking the genetic yield barrier, improving input use efficiency and developing environmentally acceptable strategies for alleviating pest losses. This phenomenal increase can be attributed to the large scale adoption of improved rice varieties and other production technologies. In Tamil Nadu out of the total 20.5 lakh hectares of area under rice, nearly three-fourth of the area is in the samba/ late samba season (wet season) coinciding with North East monsoon months of September-January. Medium duration varieties maturing in 135 days are the requirements of this season. In Tamil Nadu medium duration rice varieties *viz*., CO 43, Improved white Ponni, IR 20, ASD 19 and ADT 39 are cultivated. These varieties are susceptible to pests and diseases and the variety with high yield performance and biotic stress resistance is needed to increase the rice production level. With this in view, medium duration rice variety CO(R) 50 was developed with a new plant type architecture which in turn gives high grain yield with pest and disease resistance.

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## Materials and Methods

Department of Rice, Tamil Nadu Agricultural University, Coimbatore during kharif 1999 and the homozygous line was fixed as CB 01001 in F4 generation during kharif 2001. Culture CB 01001 was evaluated in different yield trials viz., On station trials from 2001-2004, Multi Location Trial (MLT) for two years in 2005-06 and 2006-07 conducted at different research stations of TNAU and Adaptive Research Trial (ART) in the farmers holdings during 2006-07 which was tested in 18 districts of Tamil Nadu. Under All India Coordinated Rice Improvement Programme (AICRIP) the culture was tested for three years from 2005-07 in Initial Varietal trial – Irrigated medium and Advanced varietal trial 1 – Irrigated medium and Advanced varietal trial 2 – Irrigated medium in the southern zone comprising Tamil Nadu, Andhra Pradesh and Karnataka. Physical and cooking quality characteristics of the culture was tested in Directorate of Rice Research, Hyderabad and Department of Rice, TNAU, Coimbatore. Pests and diseases reaction was tested in TNAU rice research stations at Coimbatore, Aduthurai, Gudalur and Madurai. Front line demonstrations were conducted from 2011-14 in different locations of Tamil Nadu.

## Results and Discussion

At Department of Rice, TNAU, Coimbatore, culture CB 01001 recorded a mean grain yield of 7101 Kg/ha over four years of station trials with 35.41 per cent improvement over ADT (R) 46. Based on the performance at station trials, culture was promoted to multi location trial (MLT) and evaluated in MLT III for two years in 2005-06 and 2006-07. Its mean grain yield was 5577 kg/ha which was 9.85 per cent higher than ADT(R) 46. Adaptive Research Trials (ART) were conducted with CB 01001 during 2006-07 in 18 districts, of which the culture out yielded the checks in 11 districts. It recorded a mean grain yield of 6476 Kg/ ha in 70 locations which was on an average, 9.01 per cent higher than ADT (R) 46. In the overall analysis, the culture, CB 01001 recorded a mean productivity of 6338 Kg/ha in six years of trials with 10.11 per cent increase over ADT(R) 46. At Alangudi, Pudukottai the culture has recorded the highest yield of 10,662 kg/ ha, demonstrating the highest yield potential of this variety (Table 1)

**Table 1. Overall yield performance of CO(R) 50 (CB 01001) in different trials**

| Name of the Trials | No. of trials | Grain Yield (Kg/ha) | | | |
|---|---|---|---|---|---|
| | | CO(R) 50 (CB 01001) | CO(R)48 | CO(R)49 | ADT(R)46 |
| Dept. of Rice®, Coimbatore Station trials (2001-2004) | 4 | 7101 (131) | 6390 (135 | 6593 (132) | 5244 ( 138) |
| Multi-location trials® MLT -III(2005-06) | 7 | 5481 (134) | | | 4873 (135) |
| Multi-location trials ® MLT-III (2006-07) | 10 | 5673 (136) | | | 5280 (137) |
| Adaptive Research trial (2006-07)$ | 70 | 6476 (136) | | | 5941 (138) |
| AICRIP – IVT – IM | 15 | 5099 | - | - | 3818 * Triguna 4319 (136) |
| AICRIP – AVT 1 - IM | 17 | 5520 (132) | | | Triguna 4230 * |
| AICRIP – AVT 2 - IM | 18 | 5387 132 | | | (136) Triguna |
| No. of trials | | 141 | | | 141 |
| Overall weighted mean yield in Kg/ha under on-station trials | | 5881 | | | 5137 |
| Percentage increase over the check under on-station trials | - | | 11.13 | 7.70 | 14.48 |
| Overall weighted Mean Yield in Kg/ ha in all the trials | | 6338 (135) | | | 5756 (138) |
| Percentage increase over the checks | | | | | 10.11 |

® Mean duration in the trials are furnished in the parenthesis * Check for AICRIP trials Triguna and the data were not included in the calculation of the weighted mean. $ Trials conducted in the farmers' holdings

CO(R) 50 variety was evaluated as IET 19321 under All India Coordinated Rice Improvement Programme for three years from 2005-07 across the country and it recorded a mean grain yield of 5784 kg/ha over ten trials representing 30.15 and 41.30 per cent increased yield over national checks Jaya and Triguna respectively. Under this trial, the culture ranked third in Tamil Nadu State and it recorded the

**Table 2. Performance of CO(R) 50 (CB 01001) in Agronomy trials**

| Characters | CO(R) 50 (CB 01001) | | | CO 43 | | |
|---|---|---|---|---|---|---|
| | Normal Transplant | SRI | Direct wet seeding | Normal Transplant | SRI | Direct wet seeding |
| No. of tillers / hill | 15-19 | 36-40 | 2-3 | 15 - 18 | 40-42 | 2-3 |
| SPAD reading at flowering | 37.50 | 39.20 | 26.40 | 38.40 | 40.80 | 36.20 |
| Plant height at harvest (cm) | 106 | 102 | 108 | 110 | 98 | 115 |
| Grains / panicle (No) | 303 | 354 | 245 | 248 | 285 | 174 |
| Grain yield (Kg/ha) | 7450 | 8820 | 6840 | 6980 | 8350 | 6250 |
| Straw yield (Kg/ha) | 8940 | 9700 | 8550 | 7500 | 9185 | 7750 |
| Crop duration (seed to seed days ) | 138 | 130 | 135 | 136 | 132 | 136 |
| Biomass yield (t/ha) | 17.40 | 20.80 | 16.20 | 15.5 | 19.0 | 14.75 |
| Agronomic efficiency (%) | 37.3 | 47.5 | 32.76 | 35.60 | 46.10 | 30.60 |

mean grain yield of 7192 kg/ha which was 10 and 12 per cent increased yield over Jaya and Triguna

TCO(R) 50 was evaluated under SRI system of cultivation in Rabi 2006-07 at Department of Rice, Coimbatore. The variety recorded better agronomic efficiency (37.3 and 47.5 % under normal and SRI respectively) than the check variety ADT (R) 46 (35.6 and 46.1% under normal and SRI systems) (Table 2). The recommended levels of fertilizer and the plant population for late samba and thaladi season rice variety holds good for this variety. However, the variety has a tendency to yield higher on application of higher 'N' dose as observed from the higher incremental yield obtained in this variety than CO 43.

**Table 3. Physiological characters of CO(R) 50 (CB 01001)**

| Characters | CO(R) 50 (CB 01001) | CO( R) 48 | CO 43 |
|---|---|---|---|
| Plant Height (cm) | 110 | 121 | 107 |
| Days to Fifty percent flowering | 109 | 108 | 108 |
| Leaf Area Index (90 – 120th day after sowing) | 7.69 | 7.26 | 7.32 |
| Leaf Area Duration (Days) (90 – 120th DAS) | 293.70 | 271.70 | 266.00 |
| Crop Growth Rate (g/m2/day) | | | |
| 50 – 75th DAS | 33.00 | 22.00 | 16.50 |
| 75 – 90th DAS | 55.83 | 81.61 | 56.50 |
| 90 – 120th DAS | 80.41 | 62.00 | 60.08 |
| Relative Growth Rate (mg/g/day) | 0.008 | 0.005 | 0.007 |
| Light Transmission Ratio | 11.30 | 12.33 | 12.61 |
| Spikelet fertility (%) | 91.03 | 86.26 | 82.32 |
| Productive tillers (%) | 100.00 | 95.40 | 95.20 |
| Total Dry matter Production (g/plant) | 108.52 | 112.69 | 100.01 |
| Single Plant Yield (g) | 54.24 | 47.21 | 40.15 |
| Harvest Index | 49.98 | 41.89 | 40.11 |

The variety CO(R) 50 confirms to the new plant type attributes by registering higher crop growth rate, leaf area and relative growth rate, better light transmission ratio, spikelet fertility and absolute productive tillers, dry matter production and harvest index. In view of its higher physiological efficiency, it also registered higher single plant yield in comparison to CO(R) 48 and CO 43 (Table 3)

CO(R) 50 is the variety with erect medium tall plant stature with a plant height of 100-120cm. It has moderate but all productive tillers (10-15), long droopy panicles (29-30cm) with complete fertility. Variety has dark greenish leaf with a length of 55.0cm (±5.0mm) and breadth of 2cm (±0.2mm). This variety is characterized with long erect boot leaf which aids in high photosynthetic efficiency. Panicle has 350-400 number of grains/panicle. Grains are straw coloured medium slender with an L/B ratio of 2.90 and 1000 grain weight of 20.5g. Milled rice colour is white and abdominal white is occasionally present (Table 4)

The variety CO(R) 50 was evaluated for two years (2005-07) at Coimbatore, Madurai and Aduthurai against the major pests and was found to be moderately resistant to stem borer, leaf folder and gall midge. It was screened against all the five epidemic diseases viz., blast, bacterial blight, sheath rot, sheath blight and rice tungro disease (RTD) under artificially inoculated conditions during 2005-06 and

**Table 4. Morphological characters (DUS descriptors) of CO(R) 50 (CB 01001)**

| Characters | Remarks |
|---|---|
| Habit | Erect, medium tall |
| Coleoptile | Green |
| Basal leaf sheath colour | Green |
| Leaf sheath | Green |
| Leaf blade colour | Green |
| Leaf pubescence | Glabrous |
| Leaf length | 55.0 cm (± 5.0 mm) |
| Leaf width | 2.00 cm (± 0.2 mm) |
| Days to 50% flowering | 100-105 days |
| Panicle exertion | Well-exerted panicle |
| Stigma colour | white |
| Apiculus colour | Light Green |
| Number of effective tillers | 10-15 (under SRI it may go even up to 40 ) |
| Plant height (cm) | 100 -120 cm |
| Panicle length (cm) | 29-30 cm |
| No. of Grains/panicle | 350 - 400 |
| Panicle type | Long, compact, droopy |
| Awning | Occasionally present |
| Seed coat (Kernel) colour | white |
| Junction of auricle | Pale green |
| Grain yield per plant (g) | 60-80 g |

2006-07 and was found to be moderately resistant to blast, sheath rot, sheath blight, bacterial leaf blight and RTD recording a score of 5 in 1 to 9 scale for all the five diseases (Table 5a,5b,6a and 6b).

**Table 5a. Resistance reaction of CO (R) 50 (CB 01001) against major rice pests**

| Culture | Stemborer | GMa | | LF | |
|---|---|---|---|---|---|
| | ADTf | MDUf | | ADTa | MDUa |
| CO (R) 50 (CB 01 001) | 5 | 5 | 5 | 5 | 3 |
| ADT (R ) 46 | 7 | 7 | 5 | 3 | 3 |
| CO 43 | 7 | 7 | 7 | 5 | 3 |

f. under field condition a. under artificial condition
GM : Gall Midge
LF : Leaf folder
MDU: Madurai ; ADT: Aduthurai

rice recovery (66.5%). It has intermediate amylose content (24.0%), gelatinization temperature and soft gel consistency which are the desirable traits for good cooking quality (Table 7). Intermediate amylose

Variety CO(R) 50 has medium slender grain type with good milling percentage (71.6%) and head

**Table 5b. Resistance reaction of CO (R) 50 (CB 01001) against major rice pests**

| Culture | BPH | WBPH | GLH | Stemborer | LF | | |
|---|---|---|---|---|---|---|---|
| | CBE[a] | MDU[f] | CBE[a] | CBE[a] | MDUf DH | MDUf WE | |
| CO (R) 50 (CB 01 001 ) | 5 | 7 | 5 | 7 | 3 | 5 | 5 |
| ADT (R ) 46 | 5 | 9 | 7 | 9 | 3 | 7 | 5 |
| CO 43 | 9 | 9 | 9 | 9 | 3 | 7 | 5 |

f. under field condition
a. under artificial condition
DH : Dead heart (stem borer)
WE : White ear (stem borer
BPH : Brown plant hopper
WBPH : White backed plant hopper
GLH : Green leaf hopper
LF : Leaf folder
CBE: Coimbatore ; MDU: Madurai

content remains non sticky and tender after cooking and rice with intermediate gelatinization temperature is more preferable in India (Prabhavati et al., 2007)

**Table 6a. Resistance reaction of CO (R) 50 (CB 01001) against major rice diseases**

| Culture | BLASTa | Sheath rot | BLBa | Sheath blighta | Brown spot | RTDa | |
|---|---|---|---|---|---|---|---|
| | ADT | | | CBE | | | |
| CO (R) 50 (CB 01001) | 5 | 5 | 5 | 5 | 5 | 3 | 5 |
| ADT (R) 46 | 6 | 5 | 5 | 9 | 7 | 5 | 5 |
| CO 43 | 8 | 9 | 5 | 7 | 7 | 5 | 5 |

**Table 6b. Resistance reaction of CO(R) 50 (CB 01001) against major rice diseases**

| Culture | BLAST | | | SHEATH ROT | | |
|---|---|---|---|---|---|---|
| | CBEa | GDR | MDU | ADT | CBEa | MDU |
| CO (R) 50 (CB 01001) | 5 | 1 | 5 | 5 | 7 | 7 |
| ADT (R) 46 | 3 | 5 | 5 | 5 | 9 | 9 |
| CO 43 | 5 | 5 | 7 | 7 | 9 | 5 |

**a. under artificial condition**

| Culture | BLB | | Sheath blight | | Brown spot | | RTD |
|---|---|---|---|---|---|---|---|
| | ADT | MDU | CBE | MDU | ADT | GDR | CBE |
| CO (R) 50 (CB 01001) | 7 | 5 | 5 | 5 | 5 | 5 | 5 |
| ADT (R) 46 | 7 | 5 | 7 | 7 | 5 | 5 | 5 |
| CO 43 | 7 | 5 | 5 | 7 | 5 | 7 | 9 |

BLB : Bacterial Leaf Blight RTD : Rice Tungro Disease
CBE: Coimbatore ; GDR : Gudalur ; MDU: Madurai ; ADT: Aduthurai

For popularizing the new variety CO (R) 50 among the farming community, front line demonstrations were organized in different districts of Tamil Nadu for the past three years (2011-14) with different medium duration check varieties. The yield performance of CO (R) 50 was found to be high in all the demonstrations conducted when compared to the check varieties. During 2011-12, maximum grain yield of 7500 kg/ha was recorded in kulipirai village of Pudukottai district with an yield increase of 20 per ent over BPT 5204 (5250 kg/ha). During 2012-13, nine one hectare demonstrations were organized in three districts of Tamil Nadu viz., Thiruvannamalai, Thanjavur and Cuddalore wherein highest yield of 8010 kg/ha was recorded in Nayampadi village of Thiruvannamalai district with an yield increase of 29.19 percentage over IR 20 (6200 kg/ha), followed by 7000 kg/ha at Sembiankilari village of Thanjavur district against CO 43 (5450 kg/ha). This variety was also compared with another check variety ADT (R) 46 in the same village where CO (R) 50 recorded 6750 kg/ha with 27.35 and 30.56 percentage yield increase over ADT (R) 46.

**Table 7. Quality characteristics of CO (R) 50 (CB 01 001)**

a) Milling quality traits

| Variety | Hulling % | Milling % | Head Rice Recovery % |
|---|---|---|---|
| CO (R) 50 | | | |
| (CB 01001) | 81.0 | 71.6 | 66.5 |
| ADT (R ) 46 | 78.0 | 58.0 | 52.5 |
| CO 43 | 75.0 | 60.0 | 55.0 |

**b) Physical grain quality traits**

| Variety | Kernal Length (mm) | Kernal Breadth (mm) | LB ratio | Grain type |
|---|---|---|---|---|
| CO (R) 50 | | | | |
| (CB 01001) | 6.10 | 2.10 | 2.90 | MS |
| ADT (R ) 46 | 6.80 | 2.10 | 3.24 | |
| CO 43 | 6.45 | 2.30 | 2.80 | MS |

**c) Cooking quality traits**

| Variety | KLAC (mm) | KBAC (mm) | LER | BER | VE (ml) | GT | GC |
|---|---|---|---|---|---|---|---|
| CO (R) 50 (CB 01001) | 11.00 | 3.50 | 1.80 | 1.66 | 5.2 | Intermediate to high | Soft |
| ADT (R ) 46 | 11.00 | 3.40 | 1.78 | 1.36 | 4.9 | Intermediate to high | Soft |
| CO 43 | 11.0 | 3.4 | 1.8 | 1.50 | 5.0 | Intermediate to high | Soft |

**d) Biochemical properties of CB 01 001**

| Traits | CO (R) 50 (CB 01001) | ADT (R ) 46 | CO 43 |
|---|---|---|---|
| Amylose content (%) | 24.00 | 24.16 | 23.12 |

(Mean of tests conducted at DRR and Department of Rice, TNAU, Coimbatore)

KLAC : Kernel Length After Cooking ; KBAC : Kernel Breadth After Cooking; LER : Linear Elongation Ratio; BER : Breadthwise Elongation Ratio; VE: Volume Expansion;

GT: Gelatinization Temperature ; GC: Gel Consistency

**Table 8. Front line demonstration of CO(R) 50 rice variety**

| Year | Location | CO(R) 50 Yield (kg/ha) | Check variety | Check Yield (kg/ha) | Percentage over the check |
|---|---|---|---|---|---|
| 2011-12 | Mayiladuthurai, Nagapattinam | 7437 | BPT5204 | 6071 | 22.50 |
| 2011-12 | Mannarkudi, Tiruvarur | 6900 | BPT5204 | 5484 | 25.82 |
| 2011-12 | Kulipirai, Pudukottai | 7500 | BPT5204 | 6250 | 20.00 |
| 2012-13 | Nayampadi,Kallaraipadi(Po) Chengam Taluk,Tiruvannamalai | 8010 | IR 20 | 6200 | 29.19 |
| 2012-13 | Thiruvaiyaru,Thanjavur | 6500 | CO 43 | 5010 | 29.74 |
| 2012-13 | Sembiankilari 1,Thanjavur | 6750 | ADT 38 | 5250 | 28.57 |
| 2012-13 | Sembiankilari 2, Thanjavur | 7000 | CO 43 | 5450 | 28.44 |
| 2012-13 | Sembiankilari 3, Thanjavur | 6750 | ADT(R) 46 | 5300 | 27.35 |
| 2012-13 | Sembiankilari 4, Thanjavur | 6750 | CO 43 | 5250 | 28.57 |
| 2012-13 | Sembiankilari 5, Thanjavur | 6750 | ADT(R) 46 | 5170 | 30.56 |
| 2012-13 | Sembiankilari 6, Thanjavur | 6500 | IR 20 | 5100 | 27.45 |
| 2012-13 | Pennai Nagar,Kondoor(Po.) Cuddalore | 6750 | IR 20 | 5025 | 34.32 |
| 2013-14 | Sivalingapuram, Erode | 6300 | IR 20 | 5350 | 17.75 |
| 2013-14 | Puliyamparai,Nilgiris district. | 5000 | Bharathi | 3000 | 66.67 |
| 2013-14 | Puliyamparai, Nilgiris district. | 5500 | Bharathi | 3500 | 57.14 |
| 2013-14 | Kothervayal, Nilgiris district. | 5700 | Bharathi | 3400 | 67.64 |
| 2013-14 | Kothervayal, Nilgiris district. | 4000 | Bharathi | 3000 | 33.33 |
| 2013-14 | Puliyamparai, Nilgiris district. | 5000 | Bharathi | 3200 | 56.25 |
| 2013-14 | Kuttimuchi, Nilgiris district. | 5000 | Bharathi | 3200 | 56.25 |

During 2013-14, the performance of CO(R) 50 was tested one at Erode district and in hilly areas, particularly in Nilgiris district in six locations. The check varieties IR 20 and Bharathi were used for comparing the performance of CO (R) 50. Highest yield of 5700 kg/ha for CO (R) 50 was recorded at Kotheravayal village of Nilgiris district against the check variety Bharathi (3400 kg/ha) followed by 5500 kg/ha at Puliyamparai village (Source: Field Level Demonstrations on Rice Report 2011-12, 2012-13,2013-14 and 2014-15, Directorate of Rice Research, Hyderabad). The overall performance of CO (R) 50 in different locations of Tamil Nadu showed that this variety has high yield potential over the popular medium duration varieties that are grown in Tamil Nadu (Table 8).

Medium duration rice CO(R) 50 is a medium tall, new plant type, non lodging, high yielding (6.34 t/ha) variety with moderate resistance to stem borer, leaf folder and gall midge. It is moderately resistant to blast, sheath blight, BLB and rice tungro diseases. It produces medium slender white rice with good cooking and organo-leptic properties and hence readily accepted by millers, traders and consumers

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