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Research Article

# Blackgram CO 7: A new high yielding and bold seeded variety suitable for Tamil Nadu

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**Abstract**
Blackgram (*Vigna mungo* L.) is an important pulse crop in Tamil Nadu. An inter sub- specific cross was made VBN (Bg) 5 x *V. mungo* var. *silvestris* (22/10) to develop high yielding variety with yellow mosaic disease resistance. A high yielding blackgram culture (COBG 10-05) was identified and evaluated in different yield trials from 2012 to 2020. The culture matures in 60 - 65 days. It recorded an overall mean yield of 881 kg/ha which is 12.1 , 12.4 and 14.4 per cent yield increase over the check varieties *viz.,* CO 6 (786 kg/ha) , VBN 6 (784 kg/ha) and VBN 8 (770 kg/ha), respectively. This culture is resistant to mungbean yellow mosaic virus disease and moderately resistant to leaf crinkle and stem necrosis diseases. It has bold seeds with 100 seed weight ranged from 5.5 to 6.0 g. The plant type is determinate with synchronized maturity and suitable for single/mechanical harvest. It contains 22.3 per cent protein. This culture was released as Co 7 and it is recommended for cultivation during *kharif* and *rabi* seasons in Tamil Nadu.

**Key words** : Blackgram, CO 7, High yield, Bold seeds, MYMV disease resistance

## INTRODUCTION

Pulses are the major source of dietary protein in the vegetarian diet of India. Besides being the source of protein, they maintain soil fertility through biological nitrogen fixation and thus play a vital role in furthering sustainable agriculture. Pulse crops contain macro and micronutrients (Ca, P, K, Fe and Zn), vitamins (niacin, vitamin A, ascorbic acid, inositol), fiber and carbohydrate for balance nutrition. Growth performance of pulses in terms of area, production and yield has been slow in India for the past years. The anticipated pulse requirement in India to feed the population by 2030 is 32 million tonnes (Anonymous, 2014) and would require a growth rate of 4 per cent per annum (Kumar, 1998). During recent years people are recognizing the nutritional superiority and health benefits of pulses compared to other grains. There is an increase in demand for pulses due to increased awareness of people about inclusion of pulses in daily meals for healthy living.

Blackgram (*Vigna mungo* L.) is an important pulse crop in India. It is a self-pollinated legume crop cultivated in almost all parts of India. India has the largest production and consumption of blackgram in the world. The total area under blackgram cultivation in India is 56.02 L. ha. with a production of 30.60 L.T. The average productivity of blackgram in India is 546 kg/ha (Annual report, 2019). In Tamil Nadu, it is cultivated in 4.30 L. ha. with a production of 3.11 L.T. (Tamil Nadu Salient Statistics on Agriculture, 2021). It contains protein (25 – 26%), carbohydrates (60%), fat (1.5%), minerals, amino acids and vitamins (Archana *et al.*, 2018). Mungbean Yellow Mosaic Virus (MYMV) disease is one of the devasting

diseases in blackgram in Tamil Nadu and causes yield loss of 80 to 100 % (Vinoth and Jayamani, 2014). Leaf crinckle disease is one of the emerging and threatening diseases of south India due to its seed transmitted nature. The processing industries prefer bold seeded varieties in order to get high recovery of dhal and to prevent processing loss. Therefore, breeding high yielding cultivars with resistance is an important objective in most of the blackgram improvement programme. Therefore, an attempt was made to develop blackgram variety with high yield and resistance to MYMV disease.

## MATERIALS AND METHODS

The blackgram culture COBG 10-05 is a cross derivative of VBN(Bg) 5 x *V. mungo* var. *silvestris* (22/10) and was developed at Department of Pulses, Tamil Nadu Agricultural University, Coimbatore. Superior plants with desirable traits along with MYMV resistance was selected from $F_2$ generation. In advanced generations, progenies were selected for homozygosity, yield along with disease resistance. It was evaluated with check varieties in Multi location trial (MLT), Adaptive research trial (ART), On Farm Trial (OFT) and in AICRP trials (2012-2020). Thus, a total of 187 trials were conducted. The resistance of COBG 10-05 for major pests and diseases were also studied. MYMV disease screening was done at hot spot locations (Vamban and Pampozhi) and also through agroinoculation at Centre for plant molecular biology and biotechnology, Coimbatore. Filed screening of yellow mosaic disease was done during *kharif* and summer seasons at Vamban and Panpozhi, respectively using infector row technique. A susceptible check variety CO 5 was used as susceptible check in both filed and artificial screening. Field screening was done for leaf crinkle and stem necrosis diseases using standard screening methods. The physical, chemical, organoleptic test and battering qualities were assessed by standard procedure at Community Science College and Research Institute, Madurai. Based on the results of yield and quality trials, the release proposal was submitted to the State Variety Release Committee, Government of Tamil Nadu during 2021 to release this culture as CO 7.

## RESULTS AND DISCUSSION

Blackgram CO 7 (COBG 10-05) has recorded an overall mean yield of 881 kg/ha which is 12.1 , 12.4 and 14.4 per cent yield increase over the check varieties *viz.,* CO 6 (786 kg/ha) , VBN 6 (784 kg/ha) and VBN 8 (770 kg/ha), respectively. It matures in 60 -65 days (**Table 1**).In station trials, it recorded a mean yield of 997 kg/ha which is 14.3 per cent increased yield over CO 6. In multi-location trials, this culture COBG 10-05 has recorded 790 and 709 kg/ha during *kharif* and r*abi* seasons, which is 10.3 and 13.9 per cent increased yield over the check varieties CO 6 and VBN 6, respectively (**Table 1**).

In adaptive research trials conducted over 125 locations, it recorded an average yield of 850 kg/ha which is 6.4 and

**Table 1. Performance of blackgram culture COBG 10- 5 in various trials**

| Season& Year | Seed yield (kg/ha) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number of locations | COBG 10-05 | CO 6 | VBN 6 | VBN 8 | VBN 11 | Uttara | TU 94-2 | LBG 752 | LBG 645 |
| Station (2009-2012) | 6 | 997 | 872 | - | - | - | - | - | - | - |
| MLT (*Kharif* 2012) | 7 | 790 | 716 | 883 | - | - | - | - | - | - |
| MLT (*Rabi* 2012-13) | 4 | 709 | 718 | 622 | - | - | - | - | - | - |
| ART (*Kharif* 2013-14) | 64 | 837 | 776 | 784 | - | - | - | - | - | - |
| ART (*Rabi* 2013-14) | 61 | 861 | 825 | 807 | | - | - | - | - | - |
| OFT (2014-16) | 20 | 1098 | 755 | 710 | - | - | - | - | - | - |
| OFT (2017-18) | 5 | 856 | 761 | - | - | - | - | - | - | - |
| OFT (2018-19) | 10 | 837 | 733 | - | 745 | - | - | - | - | - |
| OFT (2019-20) (Large Scale) | 7 | 937 | - | - | 805 | - | - | - | - | - |
| OFT (2020-21) (Large Scale) | 2 | 850 | 644 | - | - | - | - | - | - | - |
| OFT (2020-21) (Large Scale) | 1 | 1400 | - | - | - | 1225 | | | | |
| AICRP IVT (*Kharif*2012) | 23 | 925 | - | - | - | - | 917 | 885 | 1075 | - |
| AICRP IVT (*Rabi* 2012-13) | 4 | 865 | - | - | - | - | | | 798 | 958 |
| Weighted Mean | 187 | 881 | 786 | 784 | 770 | - | 917 | 885 | 974 | 958 |
| % increase over checks | | | 12.1 | 12.4 | 14.4 | | | - | - | - |

6.8 per cent yield increase over the check varieties *viz*., CO 6 (799 kg/ha) and VBN 6 (796 kg/ha), respectively. In OFT trials conducted over 37 locations with CO 6, this culture recorded a mean yield of 981 kg/ha which is 32 per cent yield increase over CO6 (743 kg/ha). In OFT trials conducted over 17 locations with VBN 8, this culture recorded a mean grain yield of 878 kg/ha which is 14 per cent yield increase over VBN 8 (770 kg/ha). Large scale demonstration was conducted in comparison with the recently released blackgram variety VBN 11. The culture COBG 10-05 has recorded an average yield of 1400 kg/ha which is 14.3 per cent increased yield over the check variety VBN 11 (1225 kg/ha) In AICRP- IVT trial conducted over 27 locations across India, it recorded mean grain yield of 916 kg/ha (**Table 1**).

The blackgram culture COBG 10-05 was evaluated in drip irrigation during *kharif,* 2020. The result clearly indicated that seed yield and yield parameters were significantly influenced by drip fertigation. The treatment with 100% RDF through WSF recorded significantly higher number of pods per plant (115) and seed yield (1244 kg/ ha). However, it was on par with 75% RDF through WSF (104.8 pods per plant and seed yield of 1145 kg/ ha). The lowest number of pods per plant (66.1) and seed yield (769 kg/ ha) were recorded by surface irrigation with soil application of 100% RDF (farmer's practice). Further, the per cent of seed yield increase over surface irrigation by drip fertigation of 100 and 75 % RDF through WSF was 61.7 and 48.9 per cent, respectively (**Table 2a**).

The highest WUE of 5.66 kg per ha mm, net returns of Rs. 33,564 and BCR of 1.93 were recorded with drip fertigation of 100% RDF through WSF, whereas surface irrigation and soil application of 100% RDF had the lowest WUE (2.33 kg per ha mm), net return (Rs.18,214) and BCR (1.73)(**Table 2b**).

The culture COBG 10-05 was evaluated for MYMV disease resistance during *kharif* 2020 at National Pulses Research Centre, Vamban and at Panpozhi during summer 2018 and 2019 (hot spot locations). It was also evaluated at Department of Pulses, Tamil Nadu Agricultural University, Coimbatore during 2014and also through Agro-inoculation technique during 2019 and 2020. The results revealed that COBG 10-05 is resistant to MYMV (**Table 3**).The culture COBG 10-05 was evaluated for leaf crinkle and stem necrosis disease resistance during *kharif* 2013,*summer* 2014 and *kharif,* 2015 at Department of Pulses, TNAU, Coimbatore (**Table 4**). The results showed that the variety is moderately resistant to leaf crinkle and stem necrosis diseases.

**Table 2a. Effect of drip fertigation on yield and component traits of Blackgram culture COBG 10-05**

| Treatments | Plant height (cm) | Number Primary branches | Number of cluster plant$^{-1}$ | Number of pods cluster$^{-1}$ | Number of pods plant$^{-1}$ | Number of seeds pod$^{-1}$ | 100 Seed weight (g) | Single plant yield (g) | Seed yield (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | 38.2 | 4.4 | 32.1 | 3.9 | 93.6 | 6.8 | 6.0 | 23.2 | 963 |
| $T_2$ | 39.0 | 3.7 | 33.0 | 4.2 | 104.8 | 7.4 | 6.0 | 26.8 | 1145 |
| $T_3$ | 39.6 | 4.0 | 33.1 | 4.2 | 115.0 | 7.7 | 6.1 | 29.6 | 1244 |
| $T_4$ | 34.2 | 2.9 | 17.4 | 3.8 | 66.1 | 5.4 | 5.5 | 19.6 | 769 |
| SEd | 1.70 | 0.70 | 0.40 | 0.07 | 2.70 | 0.08 | 0.10 | 0.78 | 61.74 |
| CD(p=0.05) | 3.91 | 1.40 | 0.80 | 0.18 | 6.90 | 0.20 | 0.23 | 2.10 | 134.54 |

$T_1$ -Drip fertigation of N & K through straight fertilizer and soil application of P as basal
$T_2$ - Drip fertigation of 75 % RDF through Water Soluble Fertilizer (WSF)
$T_3$ - Drip fertigation of 100 % RDF through WSF
$T_4$ - Farmer's practice (Surface irrigation with soil application of 100% RDF as basal)
RDF: 25:50:25:20 kg of NPKS ha$^{-1}$

**Table 2b.Effect of drip fertigation on Water Use Efficiency (WUE) and economics of Blackgram culture COBG10-05**

| Treatments | Quantity of water used (mm) | WUE (kg hamm$^{-1}$) | Cost of cultivation (Rs. ha$^{-1}$) | Gross return (Rs. ha$^{-1}$) | Net return (Rs. ha$^{-1}$) | BCR |
|---|---|---|---|---|---|---|
| $T_1$ | 220 | 4.38 | 29860 | 53928 | 24068 | 1.81 |
| $T_2$ | 220 | 5.20 | 33860 | 64120 | 30260 | 1.89 |
| $T_3$ | 220 | 5.66 | 36100 | 69664 | 33564 | 1.93 |
| $T_4$ | 330 | 2.33 | 24850 | 43064 | 18214 | 1.73 |

**Table 3. Screening of COBG 10-05 for MYMV disease**

| Entry name | MYMV disease score | | | | | |
|---|---|---|---|---|---|---|
| | Coimbatore | Panpozhi | | Vamban | Agroinoculation | |
| | Summer 2014 | Summer 2018 | Summer 2019 | *Kharif* 2020 | 2019 | 2020 |
| CO BG 10-05 | 1 | 1 | 1 | 2 | 1 | 1 |
| CO 5 (check) | 7 | 7 | 9 | 9 | 6 | 7 |

**MYMV Disease Scale (1 -9)**
1-Free from disease; 2- Highly Resistant; 3- Resistant; 4- Moderately Resistant; 5- Moderately susceptible;
6&7- Susceptible; 8&9- Highly susceptible

**Table 4 . Screening of COBG 10-05 for stem necrosis and leaf crinkle diseases**

| Entry name | Stem necrosis (%) | | | Leaf crinkle (%) | | |
|---|---|---|---|---|---|---|
| | *Kharif* 2013 | *Summer* 2014 | *Kharif* 2015 | *Kharif* 2013 | *Summer* 2014 | *Kharif* 2015 |
| COBG 10-05 | 5.6 | 4.2 | 3.2 | 7.4 | 3.2 | 2.6 |
| CO 5 (check) | 5.3 | 22.5 | 18.7 | 9.7 | 17.8 | 15.9 |

**Leaf crinkle and stem necrosis (% of infected plants)**
0- Highly Resistant; 1 to 5%- Resistant; 5.1 to 10% -Moderately resistant;
10.1 to 20%- Moderately susceptible; 20.1 to 40%-Susceptible ;> 40% - Highly susceptible

**Table 5. Screening of COBG 10-05 for stem fly**

| Entry name | Stem fly damage (%) | | | |
|---|---|---|---|---|
| | *Kharif* 2012 | Grade | *Rabi* 2012 | Grade |
| COBG 10-05 | 8.5 | 4 | 25.0 | 4 |
| CO 6 | 11.9 | | 40.0 | 9 |

**Stem fly (1 to 9 grade)**
1 - Highly Resistant; 2- Resistant; 3 & 4 - Moderately resistant; 5, 6 & 7 – Susceptible ; 8 & 9 - Highly susceptible

**Table 6. Physical, protein and organoleptic characters of Blackgram culture COBG 10-05**

| Parameters | COBG 10-05 | CO 6 |
|---|---|---|
| **Physical properties** | | |
| Length (mm) | 5.0 | 4.0 |
| Breadth (mm) | 3.0 | 3.0 |
| 100 seed weight (g) | 5.4 | 4.8 |
| **Chemical properties** | | |
| Moisture (%) | 10.9 | 10.8 |
| Ash (%) | 3.5 | 3.8 |
| Protein (%) | 22.3 | 21.7 |
| Starch (%) | 58.0 | 55.0 |
| Fat (%) | 1.1 | 1.3 |
| Crude Fibre (%) | 1.0 | 1.2 |
| Calcium (mg/100 g) | 108 | 110 |
| Phosphorous (mg/100 g) | 350 | 360 |
| Zinc (mg/100 g) | 3.0 | 2.8 |
| Iron (mg/100 g) | 3.5 | 3.8 |
| Arabinose (%) | 5.9 | 6.5 |
| **Cooking quality** | | |
| Cooking time (min.) | 18.0 | 18.0 |
| Water absorption (%) | 80.0 | 80.0 |

**Table 7. Physical – chemical characters of idli batter prepared from Blackgram culture COBG 10-05**

| Entry name | Batter weight (g) | | Batter volume (ml) | | | pH | |
|---|---|---|---|---|---|---|---|
| | Before Fermentation | After Fermentation | Before Fermentation | After Fermentation | Increased volume | Before Fermentation | After Fermentation |
| COBG 10-05 | 317 | 311 | 86 | 247 | 161 | 6.3 | 4.4 |
| VBN6 (C) | 315 | 309 | 88 | 248 | 160 | 6.3 | 4.6 |
| CO 6 (C) | 307 | 308 | 80 | 237 | 157 | 6.2 | 4.2 |

**Table 8. Batter volume of Blackgram culture COBG 10 -05 for Vada Preparation**

| Entry name | Batter volume for vada (ml/50 g) |
|---|---|
| COBG 10-05 | 139 |
| VBN 6 (check) | 138 |
| CO 6 (check) | 136 |

**Table 9. Organoleptic scores of Idli and Vada prepared using blackgram culture COBG 10-05**

| Culture/ Checks | Colour and appearance | Texture | Taste | Flavour | Overall acceptability |
|---|---|---|---|---|---|
| Idli | | | | | |
| COBG 10-05 | 8.5 | 9 | 9 | 8.5 | 8.5 |
| VBN6 (C) | 9 | 9 | 8 | 8 | 8.5 |
| CO 6 (C) | 8 | 8.5 | 8.5 | 8.5 | 8.3 |
| Vada | | | | | |
| COBG 10-05 | 8 | 8 | 8 | 8 | 8 |
| VBN6 (C) | 7 | 7 | 8 | 8 | 7.5 |
| CO 6 (C) | 8 | 8 | 8 | 8 | 8 |

**Table 10. Morphological features of blackgram variety CO 7**

| S. No. | Characteristics | COBG 10-05 |
|---|---|---|
| 1. | Hypocotyl: Anthocyanin colouration | Present -Purple |
| 2. | Days to 50 per cent flowering | Early (30 - 35 days) |
| 3. | Plant growth habit | Erect |
| 4. | Plant habit | Determinate |
| 5. | Stem colour | Green with purple splashes |
| 6. | Stem pubescence | Present |
| 7. | Leaflet (terminal) shape | Lanceolate |
| 8. | Foliage colour | Green |
| 9. | Leaf vein colour | Green |
| 10. | Leaf pubescence | Present |
| 11. | Petiole colour | Green with purple splashes |
| 12. | Pod: Intensity of green colour of premature pods | Green |
| 13. | Pod pubescence | Present |
| 14. | Peduncle length | Long (10.5 -11.1cm) |
| 15. | Pod length | Small (4.5 to 5.0cm) |
| 16. | Pod colour of mature pod | Black |
| 17. | Plant height | Short (40 to 45 cm) |
| 18. | Seed colour | Black |
| 19. | Seed lusture | Dull |
| 20. | Seed shape | Globose |
| 21 | Seed size ( weight of 100 seeds) | Large (5.5 to 6.0 g) |

**Fig. 1. Field view of Blackgram CO 7**

**Fig. 2. Seed characteristics of Blackgram CO 7**

The culture COBG 10-05 was evaluated for stem fly resistance during *kharif,* 2012 and *rabi* 2012-13 at Department of Pulses, Tamil Nadu Agricultural University, Coimbatore (**Table 5**). The results showed that the variety is moderately resistant to stem fly.

The culture contains a protein content of 22.3 per cent and with good mineral composition (**Table 6**). The culture COBG 10-05 is ideally suited for making dishes like vada and idli due to its high battering capacity. The idli batter volume increased three times after fermentation (**Table 7**). The vada batter volume obtained was 139 ml/50 g (**Table 8**). The overall acceptability score for COBG 10- 05 was more than 8 out of 10(**Table 9**). The blackgram culture COBG 10-05 matures in 60 -65 days (**Table 10 and Fig.1**). It is erect plant type with broad leaves at bottom and lanceolate leaves in upper part of the plant. It is determinate plant, plant height ranges from 40 – 45 cm with synchronized maturity and hence suitable for single/mechanical harvest. The colour of the stem and petiole is green with purple splashes. Dense pubescent is present on leaves, stem and pods. The seeds are black, globose, dull seed luster and bold seeded. The 100 seed weight ranges from 5.5 to 6.0 g (**Fig .2**).

Based on the better performance of COBG 10 -05, it was released as CO 7 by the State Variety Release Committee during 2021. It is notified (S.O.8(E), 24.12.2021) for cultivation during *kharif* and *rabi* seasons for blackgram growing districts of Tamil Nadu.

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