A new high yielding, charcoal rot and yellow mosaic virus disease resistant soybean variety AMS-1001 (PDKV Yellow Gold)

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Abstract
Soybean variety AMS-1001 is an induced mutant of JS-93-05. In multilocation trials AMS-1001 has recorded yield increase over state check MAUS-71 by 24.17% and national check JS-335 by 20.58%. In state multilocation trials AMS-1001 has recorded 36.01%, 30.58% and 33.82% increase yield over JS-335, JS-97-52 and MAUS-71, respectively. AMS-1001 has also given 23.90% higher seed yield over check variety JS-335, in adaptive trials on farmer’s field. This culture has shown highly resistant reaction to charcoal-rot and YMV diseases. It has medium maturity duration, determinate growth habit, purple flower, glabrous pods/stem with pointed ovate dark green leaves. AMS-1001 differentiated from other soybean varieties using molecular markers and primer Glysatt-180 was found specific to the sample AMS-1001 and can be used for its identification. Considering its yield superiority and resistance diseases the SVRC has released this culture as AMS-1001 (PDKV Yellow Gold) for Maharashtra state. The national identity of this variety is IC 626343.

Key words
Soybean, AMS-1001, charcoal rot and yellow mosaic virus

INTRODUCTION
Soybean (Glycine max L. Merril) is the world most important seed legume, which contributes to 25% of the global edible oil, about two-thirds of the world’s protein concentrate for livestock feeding. Soybean meal is a valuable ingredient in formulated feeds for poultry and fish (Agarwal et al., 2013). It is therefore no surprise that global soybean demand is increasing rapidly. India stands fifth in soybean production. Soybean has emerged as one of the major oilseed crop and revolutionized rural economy and lifted the socio economic status of soybean growing farmers in India. With unparallel growth, the area and production of soybean in India reached 10.96 million ha and 13.46 million tons respectively (Anonymous, 2019).

However, productivity is not more than half of the world average; hence, there is a tremendous scope to increase soybean production by enhancing productivity. Improved varieties, in any crops are essential for achieving higher productivity. Lack in diversification of varieties is a major constraint of productivity. About more than 115 varieties have been released in India but most of the varieties have narrow genetic base and hence restricted to grow on small area. Soybean culture AMS-1001 has ability to produce sustainable optimum yield facing newly emerged problems of Root Rot/Charcoal Rot and yellow mosaic virus disease in the Vidarbha region. The mutant AMS 1001 is high yielding than the parent variety JS 93-05 and recorded 10.90% and 38.29% increase in station trial and AllCRIP trial, respectively. AMS-1001 is resistant to charcoal-rot and YMV diseases.

Root rot/ Charcoal Rot caused by Macrophomina phaseolina/ Sclerotium rolfsii are the severe menace in soybean cultivation particularly in Maharashtra state. A yield reduction is caused from post emergence death of seedlings, weakening of plants, root rot, collar rot as well as premature death of infected plants. Being seed and soil borne polyphagus pathogen, it is difficult to manage in field (Chavan and Gupta, 2005).
Yellow mosaic virus (YMV) is a serious and widespread disease of soybean in India and nearly all the major varieties grown in the central India are susceptible to YMV (Bhattacharyya et al., 1999). The magnitude of yield loss due to YMV in soybean has been reported to be as high as 80 per cent (Nene, 1972). YMV is transmitted by whitefly (Bemisia tabaci); therefore, control of this disease is indirectly related to the control of its vector. Its chemical or cultural control has not been found to be economical and environmental friendly.

Therefore, the most effective way to prevent the occurrence of these diseases are to develop genetically resistant cultivars. Hence, AMS-1001 (PDKV Yellow Gold) has been developed and released as high yielding new variety with resistance to charcoal rot and yellow mosaic virus diseases.

**MATERIALS AND METHODS**

Considering the previous studied regarding LD50 and effective doses of gamma rays in soybean crop improvement (Van-Harten, 1998; Karthika and Lakshmi, 2006; Pavadai, 2006), irradiation of seed material of soybean variety JS-9305 was done with three treatments viz., 150 Gy, 250 Gy & 300 Gy at Bhabha Atomic Research Centre, Trombay, Mumbai in the year 2006. The treated seed material was sown during kharif 2006 at Research Farm of Regional Research Center (Dr. PDKV), Amravati to raise the M1 population. The seed of each M1 plant was harvested separately. In kharif 2007 the M2 population was raised. Intensive selection was done in M1 population for desirable mutants. Among these mutants one unique mutant (Plant No.100) with 86 mm long secondary root length with series of nodules was observed which was named as AMS-1001 and was tested for yield performance in 10 meter row length. The soybean culture AMS 1001 was tested in Preliminary and Advanced Yield Trials along with the check varieties from 2012 to 2017. Based on superiority in University Multilocation Varietal Trials (MVT) it was promoted in State Multilocation Varietal Trial for testing over different locations of Maharashtra state during kharif 2013 and 2014 and also nominated for evaluation under AICRP trials during Kharif 2013. The culture AMS-1001 was pre-released during the year 2016 by Research Review and Finding Committee of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The adaptive trials (on farm trial) were conducted on farmer’s field during kharif 2017. The culture AMS-1001 was also screened for major diseases and inset-pests. The resistance of this culture to root rot/charcoal rot was tested in natural as well as sick plot condition.

Considering its superior yield performance and resistance to charcoal rot and yellow mosaic virus disease State Variety Release Committee approved and released it as a Soybean variety AMS-1001 (PDKV Yellow Gold) in 2018.

**Table 1. Overall seed yield performance of soybean AMS-1001 in different trials.**

| Sr. No. | Name of Trial                        | No. of trials / locations | AMS-1001 | Checks       |
|---------|-------------------------------------|---------------------------|----------|--------------|
|         |                                     |                           |          | JS-335/71    |
| 1       | Station Trial (2011)                | 1                         | 2563     |              |
|         | Per cent yield increase             |                           |          | JS 93-05     |
|         |                                     |                           |          | JS 97-52     |
| 2       | MVT (2012 to 2017)                  | 30                        | 2173     | 20.58/24.17  |
|         | Per cent yield increase             |                           |          |              |
| 3       | SMVT (2013 & 2014)                  | 22                        | 1998     | 36.01/33.82  |
|         | Per cent yield increase             |                           |          |              |
| 4       | IVT (AICRP) (2013)                  | 4                         | 1784     | 12.91/38.29  |
|         | Per cent yield increase             |                           |          |              |
| 5       | Adoptive Trials (On farmers field) (2017) | 20                       | 1749     | 23.90        |
|         | Per cent yield increase             |                           |          |              |

Source: Annual Research Review Committee Report of Soybean Breeding 2012-13 to 2017-18

**RESULTS AND DISCUSSION**

The culture AMS-1001 is the mutant of soybean variety JS 93-05. AMS-1001 has determinate growth habit and mature in 95 to 100 days. In station trial conducted during kharif 2011, the culture AMS-1001 has given the 2563 kg/ha seed yield, which was 10.90 per cent higher seed yield than national check JS 93-05 (Table 1). Based on the yield performance in station trial the culture AMS-1001 was promoted to Multiocation Varietal Trial (MVT) and evaluated for six years from kharif 2012 to kharif 2017, over 30 locations. Based on average seed yield over six years the culture AMS-1001 (2173 kg/ha) has recorded 24.17% and 20.58% increase in seed yield over state check MAUS-71 (1750 kg/ha) and over national.
Table 2. Seed yield performance of soybean AMS-1001 in Multilocation Varietal Trials (MVT)

| Year of testing | No. of Locations/trails | AMS-1001 | Checks |
|-----------------|-------------------------|----------|---------|
|                 |                         |          | JS-335 (NC) | MAUS-71 (LC) |
| 2012            | 6                       | 2619     | 2365   | 2222 |
| 2013            | 5                       | 2490     | 2150   | 2063 |
| 2014            | 5                       | 1586     | 1324   | 1482 |
| 2015            | 4                       | 1903     | 937    | 1076 |
| 2016            | 5                       | 2683     | 2529   | 2346 |
| 2017            | 5                       | 1615     | 1221   | 1064 |
|                 |                         | 30       | 2173   | 1802 | 1750 |
| Overall % increase over checks |                      |          | 20.58 | 24.17 |

Source: Annual Research Review Committee Report of Soybean Breeding 2012-13 to 2017-18

Table 3. Seed yield performance of soybean AMS-1001 in State Multilocation Varietal Trials (SMVT)

| Years | No. of Locations | AMS-1001 | Checks |
|-------|------------------|----------|--------|
|       |                  |          | JS-335 (NC) | JS 97-52 (NC) | MAUS-71 (LC) |
| 2013  | 11               | 2235     | 1954   | 1872 | 1972 |
| 2014  | 11               | 1762     | 985    | 1189 | 1015 |
|       | 22               | 1998     | 1469   | 1530 | 1493 |
| Overall % increase |                      |          | 36.01 | 30.58 | 33.82 |

Source: Annual Research Review Committee Report of Soybean Breeding 2013-14 to 2014-15

Table 4. Yield performance of Soybean AMS-1001 in All India Coordinated Trial: Initial Varietal Trial (IVT)

| Year | Locations  | Seed yield (kg/ha) | C. D. (kg/ha) | C.V. (%) |
|------|------------|--------------------|---------------|----------|
|      |            | AMS-1001 | JS 95-60 | JS 93-05 | JS-335 |
| 2013 | Amravati   | 2593     | 2025    | 1531    | 1827 | 271.60 | 10.90 |
|      | Jalna      | 1481     | 543     | 1160    | 1284 | 271.60 | 14.69 |
|      | Nagpur     | 1012     | 1136    | 914     | 1210 | 345.68 | 16.75 |
|      | Parbhani   | 2049     | 1160    | 1556    | 2000 | 370.37 | 13.20 |
| Mean (4) |         | 1784     | 1216    | 1290    | 1580 |            |        |
| % increase/decrease over |              | 46.71   | 38.29   | 12.91 |

Source: AICRP Annual Report on Soybean 2013-14

(Anonymous, 2013). Further in adoptive trials conducted on farmer fields (on-farm trials) of Amravati, Akola, Washim, Buldhana, Yavatmal, Nagpur and Chandrapur districts of Maharashtra, the culture AMS-1001 has given 23.90 per cent higher seed yield than check variety JS 335 (Table 1). The soybean culture AMS-1001 also screened for root rot/ charcoal rot and Yellow mosaic virus disease over the seven year from 2011 to 2017. AMS-1001 shows...
highly resistant reaction to both the diseases under natural field condition, whereas, it also shows absolute resistance to root rot/charcoal rot in sick plot (Table 5 & 6). Thus, AMS-1001 (PDKV Yellow Gold) is high yielding new variety with resistance to charcoal rot and yellow mosaic virus diseases. Similarly, during recent years, Sumathi et al., 2017 has developed high yielding downy mildew disease resistant pearl millet composite CO 10 and Pandiyan et al., 2018 has developed a new high yielding MYMV disease resistant blackgram variety VBN 8.

Table 5. Reactions to Root rot/Charcoal rot and Yellow Mosaic Virus diseases of AMS-1001 in station trials at Amravati location under natural field condition.

| Sr. No. | Disease               | Year | AMS-1001 | TAMS-38 | JS-335 | MAUs-71 |
|---------|-----------------------|------|----------|---------|--------|---------|
| 1       | Root Rot/ Charcoal rot| 2011 | AR (0.00) | HS (100.00) | MR (30.40) | AR (0.00) |
|         |                       | 2012 | AR (0.00) | HS (100.00) | MS (36.10) |        |
|         |                       | 2013 | AR (0.00) | HS (98.40) | S (60.40) | AR (0.00) |
|         |                       | 2014 | AR (0.00) | HS (80.60) | S (70.10) | AR (0.00) |
|         |                       | 2015 | AR (0.00) | HS (100.00) | S (60.50) | MR (17.40) |
|         |                       | 2016 | HR (5.60) | HS (100.00) | MR (14.50) | MR (22.14) |
|         |                       | 2017 | HR (8.40) | HS (100.00) | MS (40.50) | HR (10.10) |
|         | Average rating         |      | HR (2.00) | HS (97.00) | MS (44.64) | AR (8.27) |

*Data not considered as infection index below susceptible level in check

Source: Annual Research Review Committee Report of Plant Pathology 2011-12 to 2017-18

Scale of Ratings:
- AR-O %  4) MS-34 to 55 %
- HR-1 to11 %  5) S- 56 to 77 %
- MR-12 to 33 %  6) HS-78 to 100 %

Table 6. Reaction to Root rot diseases of AMS-1001 in station trials under sick plot condition at Amravati location.

| Genotype | Year & Reaction to Root rot |
|----------|-----------------------------|
|          | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| AMS-1001 | AR (0.00) | AR (0.00) | AR (0.00) | AR (0.00) | AR (0.00) | AR (0.00) | HR (10.50) |
| TAMS 38 ©| HS (100.00) | HS (100.00) | HS (100.00) | HS (100.00) | HS (100.00) | HS (100.00) | HS (100.00) |
| JS 335 ©| MS (35.50) | MS (34.50) | S (76.20) | HS (80.00) | S (74.0) | HS (90.00) | MS (52.50) |

Source: Annual Research Review Committee Report of Plant Pathology 2011-12 to 2017-18

Scale of Ratings:
- AR-O %  4) MS-34 to 55 %
- HR-1 to11 %  5) S- 56 to 77 %
- MR-12 to 33 %  6) HS-78 to 100 %
Table 7. Descriptor of soybean Variety AMS 1001 (PDKV Yellow Gold)

|   | General                  |   |
|---|-------------------------|---|
| 1.1 | Name of variety         | AMS-1001 (PDKV Yellow Gold) |
| 1.2 | Pedigree                | Mutant of JS 93-05           |
| 1.3 | Year of Development     | 2004                         |
| 1.4 | Year of Release         | 2018                         |
| 1.5 | Origin (Name of Institute) | Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola |

| 2.1 | Growth type             | Determinant                  |
| 2.2 | Growth habit            | Semi-erect                   |

| 3.1 | Colour of Flower        | Purple                       |

| 4.1 | Pod Pubescence          | Absent                       |

| 5.1 | Seed size               | Medium size                  |
| 5.2 | Seed shape              | Spherical                    |
| 5.3 | Seed Coat colour        | Light yellow                 |
| 5.4 | Hilum colour            | Grey                         |

| 6.1 | Anthocynin Pigmentation | Present                      |
| 6.2 | Pubescence on stem      | Absent                       |

| 7.1 | Leaf Size               | Medium                       |
| 7.2 | Leaf Shape              | Pointed Ovate                |
| 7.3 | Leaf Colour             | Dark green leaves            |
| 7.4 | Leaf surface            | Rough                        |

| 8.1 | Maturity range (days)   | 95-100                       |
| 8.2 | Maturity group          | Medium                       |
| 8.3 | Test weight (gm)        | 10.48                        |
The key morphological characters to distinguish this culture from other varieties during seed production are medium maturity, determinant growth habit, purple flower, glabrous pods/stem with pointed ovate dark green leaves (Table 7).

The soybean culture AMS-1001 is differentiated from parental variety JS 93-05 and also from popularly grown soybean variety JS-335 and other two control samples using molecular marker technology. Out of 18 primer used nine primers namely Glysatt-588, Glysatt-184, Glysatt-453, Glysatt-180, Glysatt-300, Glysatt-449, Satt-286, Satt-005 and Glysatt-173 were found to be polymorphic in the sample and controls and were useful for differentiating the sample. However, primer Glysatt-180 was specific to the sample AMS-1001 and can be used for identification (Fig. 1).

Considering the superiority over the check varieties the culture AMS-1001 was released as AMS-1001 (PDKV Yellow Gold) by the 50th State Seed Sub Committee (SVRC) meeting during 2018. It is recommended for kharif planting in Vidarbha region of Maharashtra. The national identity of the variety is IC 626343.

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