

## Evaluation of Ashwagandha [*Withania somnifera* (L.) Dunal] Genotypes for Growth and Yield Attributes under Bengaluru Condition

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### ABSTRACT

The present investigation was carried-out at the Department of Horticulture, College of Agriculture, UAS, GKVK, Bengaluru with the aim of evaluating thirty-two genotypes of ashwagandha [*Withania somnifera* (L.) Dunal] for growth and yield parameters under Bengaluru conditions during late *Kharif* 2020 and 2021 by adopting a randomized complete block design with three replications. Various growth and yield parameters, viz., days to 50 per cent germination, plant height, branches per plant, days to 50 per cent flowering, length of main root, diameter of main root, dry weight of root plant<sup>-1</sup> and dry root yield were recorded. Among all genotypes, DWS-319 taken minimum days to 50 per cent germination (11 days), whereas genotype DWS-132 taken maximum days to 50 per cent germination (25 days). Genotype DWS-09 was found as the superior genotype for plant height (74.25 cm), diameter of main root (2.82 cm), dry weight of root plant<sup>-1</sup> (7.57 g), dry root yield plot<sup>-1</sup> (416.35 g) and dry root yield ha<sup>-1</sup> (16.01 q). Among the genotypes, DWS-280 and DWS-279 were superior in branches per plant (17.81) and length of main root (21.67 cm) respectively. The present study indicates that genotype DWS-09 recorded the highest mean performance for growth and yield character under Bengaluru conditions.

**Keywords :** Ashwagandha, Genotypes, Evaluation, Growth and Yield

**A**SHWAGANDHA [*Withania somnifera* (L.) Dunal] (2n=48), commonly known as 'Winter cherry,' is an important cultivated medicinal crop of India. It is an erect, evergreen, perennial shrub of the Solanaceae family native to the Indian sub-continent. It is also known as 'Indian Ginseng' because the roots are compared with the roots of Chinese Ginseng (*Panax ginseng*) for their restorative properties (Devi, 1996). Several types of alkaloids are found in this plant, among which withanine and somniferine are important. The total alkaloid content in Indian type roots has been reported to range between 0.13 and 0.31 per cent. Ashwagandha fruits and seeds are diuretic in nature. The paste prepared out of its leaves is used for curing inflammation of tubercular glands and that of its roots for curing skin diseases, bronchitis and ulcers. In ancient Ayurvedic literature, ashwagandha

is mentioned as an important drug. Withaferine-A is used as an antibiotic, anti-stress, neuroprotective, antitumor, anti-arthritis, analgesic and anti-inflammatory drug. The drug is mainly used in Ayurvedic and Unani preparations. Hence, this drug is receiving a great deal of attention. It is also found useful in treating different disorders such as Parkinson's, dementia, memory loss, stress-induced diseases and malignoma. It is commonly used for emaciation of children, debility from old age, rheumatism, leucoderma, constipation, insomnia, nervous breakdown and goitre (Singh *et al.*, 2011).

Ashwagandha grows in the dry parts of sub-tropical regions. Rajasthan, Punjab, Haryana, Uttar Pradesh, Gujarat, Maharashtra and Madhya Pradesh are the major Ashwagandha producing states in the country. Recently, it has also been cultivated in the

southern states of Karnataka and Andhra Pradesh. India's annual requirement of roots is around 7000 tons while production is hardly 1400 tons since it has potential to grow under rainfed conditions and there is a need to increase its cultivation in newer areas in south India. However, there is an apparent lack of improved genotypes of ashwagandha to increase the yield potential. Therefore, the present investigation was carried out to evaluate the existing variability for higher growth and yield.

### MATERIAL AND METHODS

The present investigation, comprising 32 genotypes of ashwagandha, evaluation was carried out during 2020 and 2021 late *kharif* at the Horticulture Research Station, Department of Horticulture, College of Agriculture, UAS, GKVK, Bengaluru. The treatments included thirty-two genotypes of ashwagandha, with their sources of collection enlisted in Table 1. The experiment was conducted using Randomized Complete Block Design (RCBD) with three replications in Bengaluru conditions following 30 cm x 20 cm spacing with the individual gross plot size of 2.6 m<sup>2</sup>. The required area for experiment was marked prior to layout at Horticulture Research Station, Department of Horticulture for the years 2020, 2021 and the experimental plot was ploughed with a tractor followed by levelling and planking with a view to having a fine tilth of the experimental plot. Weeds and debris were removed so as to obtain a clean and fine tilth texture. The recommended doses of organic manures and fertilizers were applied at the time of field preparation. 10-12 tons of FYM, 15 kg of nitrogen and 25 kg of phosphorus per hectare were applied at the time of land preparation of experimental plots. Seeds were sown to a depth of 1 to 2 cm by line sowing method. The crop received regular intercultural operations and irrigation. Standard agronomic practices and plant protection measures were adopted as per the schedule. Five plants from each plot were randomly chosen and tagged in order to record observations.

The observations on various growth parameters were recorded at different growth stages at 45<sup>th</sup>,

TABLE 1  
List of ashwagandha genotypes along with their sources used in the study

Treatments	Genotypes	Sources
T <sub>1</sub>	DWS-05	DMAPR, Boriavi, Anand, Gujarat
T <sub>2</sub>	DWS-09	DMAPR, Boriavi, Anand, Gujarat
T <sub>3</sub>	DWS-22	DMAPR, Boriavi Anand, Gujarat
T <sub>4</sub>	DWS-40	DMAPR, Boriavi, Anand, Gujarat
T <sub>5</sub>	DWS-41	DMAPR, Boriavi, Anand, Gujarat
T <sub>6</sub>	DWS-132	DMAPR, Boriavi, Anand, Gujarat
T <sub>7</sub>	DWS-141	DMAPR, Boriavi, Anand, Gujarat
T <sub>8</sub>	DWS-143	DMAPR, Boriavi, Anand, Gujarat
T <sub>9</sub>	DWS-144	DMAPR, Boriavi, Anand, Gujarat
T <sub>10</sub>	DWS-197	DMAPR, Boriavi, Anand, Gujarat
T <sub>11</sub>	DWS-250	DMAPR, Boriavi, Anand, Gujarat
T <sub>12</sub>	DWS-252	DMAPR, Boriavi, Anand, Gujarat
T <sub>13</sub>	DWS-253	DMAPR, Boriavi, Anand, Gujarat
T <sub>14</sub>	DWS-257	DMAPR, Boriavi, Anand, Gujarat
T <sub>15</sub>	DWS-258	DMAPR, Boriavi, Anand, Gujarat
T <sub>16</sub>	DWS-259	DMAPR, Boriavi, Anand, Gujarat
T <sub>17</sub>	DWS-260	DMAPR, Boriavi, Anand, Gujarat
T <sub>18</sub>	DWS-262	DMAPR, Boriavi, Anand, Gujarat
T <sub>19</sub>	DWS-270	DMAPR, Boriavi, Anand, Gujarat
T <sub>20</sub>	DWS-272	DMAPR, Boriavi, Anand, Gujarat
T <sub>21</sub>	DWS-279	DMAPR, Boriavi, Anand, Gujarat
T <sub>22</sub>	DWS-280	DMAPR, Boriavi, Anand, Gujarat
T <sub>23</sub>	DWS-281	DMAPR, Boriavi, Anand, Gujarat
T <sub>24</sub>	DWS-284	DMAPR, Boriavi, Anand, Gujarat
T <sub>25</sub>	DWS-296	DMAPR, Boriavi, Anand, Gujarat
T <sub>26</sub>	DWS-309	DMAPR, Boriavi, Anand, Gujarat
T <sub>27</sub>	DWS-315	DMAPR, Boriavi, Anand, Gujarat
T <sub>28</sub>	DWS-316	DMAPR, Boriavi, Anand, Gujarat
T <sub>29</sub>	DWS-317	DMAPR, Boriavi, Anand, Gujarat
T <sub>30</sub>	DWS-319	DMAPR, Boriavi, Anand, Gujarat
T <sub>31</sub>	Arka Ashwa gandha	IIHR, Bengaluru
T <sub>32</sub>	Poshita	CIMAP Research Station, Bengaluru

Note : DMAPR –Directorate of Medicinal and Aromatic Plants  
Research

DWS- Directorate *Withania somnifera*

75<sup>th</sup>, 105<sup>th</sup>, 135<sup>th</sup> days after sowing and at harvest. The yield parameters were recorded after harvest and the replicated mean data was subjected to statistical analysis for interpretation, using Randomized Complete Block Design (Panse and Sukhatme, 1957).

## RESULTS AND DISCUSSION

### Growth Parameters

#### Days to 50 per cent Germination

Ashwagandha genotypes exhibit variability with respect to various growth parameters (Table 2). Days to 50 per cent germination were recorded and ranged from 11 to 25 days (Table 2). The genotype DWS-132 took the maximum days to 50 per cent germination (25 days), while DWS-143 (24 days) and DWS-144 (23 days) were on par with each other. Minimum days to 50 per cent germination was observed in DWS-319 and DWS-252 (11 days), followed by DWS-141 (12 days). Early germination might be attributed to a soft seed coat, whereas late germination might be attributed to the genotypes hard seed coat. The results from the present investigation are in conformity with the findings of Gami *et al.* (2015) in ashwagandha.

#### Plant Height

The plant height was found significant among genotypes and the data analysed is presented in Table 2. The data revealed that the significantly maximum plant height was found in genotype DWS-09 (74.25 cm), which was followed by DWS-309 (72.15 cm) and DWS-259 (71 cm) and the lowest plant height (42.42 cm) was recorded in genotype DWS-40. The variations in plant growth phases among different ashwagandha genotypes could be attributed to genetic traits of the individual genotype, genetic heritability and growth variability among genotypes, as well as soil and climatic conditions favourable to vigorous growth and nutrition management. Similar results were obtained by Polaiiah *et al.* (2013) and Gami *et al.* (2015) in ashwagandha.

### No. of Branches Per Plant

Analysed mean data and its range for the thirty-two genotypes with respect to branches per plant are presented in Table 2. The data revealed that the significantly maximum branches per plant was found in genotype DWS-280 (17.81), which was followed by DWS-296 (16.38) and DWS-270 (15.67) and the lowest branches per plant (6.10) was recorded in genotype DWS-132. The increased number of branches per plant could be attributed to the requirement of developing plants for more carbohydrates, which might have forced the plants of these genotypes to produce more branches. Other reason for the increased in branch number might be enhanced cell division, which might have increased the number of vegetative buds on the main stem. The variation in the number of branches among different genotypes was also reported by Sundesha *et al.* (2016) and Gami *et al.* (2015) in ashwagandha.

#### Days to 50 Per cent Flowering

Data pertaining to days to 50 per cent flowering recorded from different treatments is presented in Table 2. Significant differences were observed between the genotypes for days to 50 per cent flowering during both the years 2020 and 2021. Genotype DWS-252 recorded significantly minimum number of days to 50 per cent flowering (65 days) followed by genotypes DWS-319 and DWS-279 (66 days). The genotypes DWS-143 and DWS-257 were taken maximum number of days to 50 per cent flowering (84 days). The variation might be due to inherited genetic makeup and characteristic features of a genotype. The results from the present investigation agree with the findings of Joshi *et al.* (2014) and Gami *et al.* (2015) in ashwagandha.

### Yield Parameters

#### Length of Main Root

The length of main root was found significant among genotypes and the analysed data is presented in Table 3. The data revealed that the highest length of main root (21.67 cm) was found in DWS-279, which was followed by DWS-09 (19.65 cm) and

TABLE 2  
Performance of ashwagandha genotypes for growth and days to 50 per cent flowering

Treatments	Genotypes	Days to 50% germination	Plant height (cm)	No. of branches per plant	Days to 50 % flowering
T <sub>1</sub>	DWS-05	17	52.56	10.25	72.00
T <sub>2</sub>	DWS-09	14	74.25	12.21	67.00
T <sub>3</sub>	DWS-22	16	53.33	12.00	73.00
T <sub>4</sub>	DWS-40	18	42.42	11.67	79.00
T <sub>5</sub>	DWS-41	15	66.52	14.12	75.00
T <sub>6</sub>	DWS-132	25	53.44	6.10	80.00
T <sub>7</sub>	DWS-141	12	49.20	12.33	70.00
T <sub>8</sub>	DWS-143	24	62.50	11.20	84.00
T <sub>9</sub>	DWS-144	23	49.67	11.47	71.00
T <sub>10</sub>	DWS-197	15	51.85	9.50	72.00
T <sub>11</sub>	DWS-250	17	47.69	11.64	73.00
T <sub>12</sub>	DWS-252	11	56.22	13.35	65.00
T <sub>13</sub>	DWS-253	20	52.54	10.30	79.00
T <sub>14</sub>	DWS-257	20	53.44	14.00	84.00
T <sub>15</sub>	DWS-258	16	45.25	8.54	77.00
T <sub>16</sub>	DWS-259	21	71.00	12.42	75.00
T <sub>17</sub>	DWS-260	14	55.25	12.69	70.00
T <sub>18</sub>	DWS-262	18	60.20	12.75	74.00
T <sub>19</sub>	DWS-270	15	63.70	15.67	68.00
T <sub>20</sub>	DWS-272	14	54.30	11.90	69.00
T <sub>21</sub>	DWS-279	13	51.26	14.20	66.00
T <sub>22</sub>	DWS-280	14	58.67	17.81	73.00
T <sub>23</sub>	DWS-281	17	48.33	9.84	72.00
T <sub>24</sub>	DWS-284	13	60.71	10.46	70.00
T <sub>25</sub>	DWS-296	13	59.50	16.38	71.00
T <sub>26</sub>	DWS-309	15	72.15	11.85	73.00
T <sub>27</sub>	DWS-315	19	50.67	10.45	78.00
T <sub>28</sub>	DWS-316	16	47.55	9.56	71.00
T <sub>29</sub>	DWS-317	13	59.00	11.61	73.00
T <sub>30</sub>	DWS-319	11	65.71	14.83	66.00
T <sub>31</sub>	Arka Ashwagandha	14	54.64	10.64	72.00
T <sub>32</sub>	Poshita	14	56.59	11.13	70.00
	Mean	16.16	56.25	11.96	72.88
	S. Em (±)	0.07	0.16	0.05	0.10
	C.D. @ 5%	0.21	0.46	0.14	0.28

DWS-41 (18.86 cm) and the least length of main root (10.17 cm) was obtained in DWS-315. The variation in length of the main root among different genotypes may be due to vigour of the plant and other related plant characters. Similar results were reported by Sangwan *et al.* (2013) and Sundesha and Tank (2013) in ashwagandha.

### Diameter of Main Root

The analysed mean data with respective diameter of main root was found significant among genotypes (Table 3). The data revealed that the highest diameter of main root (2.82 cm) was found in DWS-09, which was followed by DWS-279 (2.71 cm) and DWS-41 (2.60 cm) and the least diameter of main root (1.44 cm) was obtained in DWS-143. Singh *et al.* (2017) reported that the genetic variability exists in ashwagandha for dry root yield associated with root diameter. The findings are in consistent with the results obtained by Chaudhary *et al.* (2016) and Srivastava *et al.* (2017) in ashwagandha.

### Dry Weight of Root Per Plant

The dry weight of root per plant was ranged from 3.34 to 7.57 g (Table 3). The maximum dry weight of root per plant was recorded in DWS-09 (7.57 g), followed by DWS-279 (6.80 g) and DWS-41 (6.13 g). The minimum dry weight of root per plant was observed in DWS-22 (3.34 g). The variation in the root yield may be due to variations in the genetic makeup of genotypes. Similar results were obtained by Chaudhary *et al.* (2016) in ashwagandha.

### Dry Root Yield Per Plot and Dry Root Yield Per Hectare

Dry root yield per plot ranged from 183.70 to 416.35 g (Table 3). The maximum dry root yield per plot was recorded in DWS-09 (416.35 g), followed by DWS-279 (374 g) and DWS-41 (337.15 g). The minimum dry root yield per plot was observed in DWS-22 (183.70 g). Similarly, dry root yield per hectare ranged from 7.07 to 16.01 q (Table 3). The maximum dry root yield was recorded in DWS-09 (16.01 qha<sup>-1</sup>), followed by DWS-279 (14.98 qha<sup>-1</sup>) and DWS-41 (12.97 qha<sup>-1</sup>). The

minimum dry root yield was observed in DWS-22 (7.07 qha<sup>-1</sup>). This variation might be due to differences in the vegetative growth of genotypes which lead to variation in photosynthesis and ultimately effect on dry root weight. The yield of root is directly related with higher number of branches. Similar results were reported by Patel and Desai (2017) in ashwagandha.

### Fresh Weight of Per Plant

There was significant variation among genotypes in the analysed mean data with associated fresh weight of per plant (Table 4). Data revealed that DWS-09 had the highest fresh weight per plant (133.58 g), which was on par with DWS-279 (132.19 g) and followed by DWS-41 (131.74 g) and the DWS-132 had showed the lowest fresh weight per plant (45.75 g). The findings are in consistent with the results obtained by Srivastava *et al.* (2017) in ashwagandha.

### Dry Weight of Per Plant

The dry weight of per plant was ranged from 16.79 to 45.93 g (Table 4). The maximum dry weight of per plant was recorded in DWS-09 (45.93 g), which was followed by DWS-241 (42.73 g) and DWS-279 (40.80 g). The minimum dry weight of per plant was observed in DWS-132 (16.79 g). Variations in the genotypes genetic make-up could be the source of the variance in dry weight. Similar results were obtained by Chaudhary *et al.* (2016) and Singh *et al.* (2017) in ashwagandha.

### Seed Yield Per Plant and Seed Yield Per Hectare

Seed yield per plant ranged from 2.76 to 13.87 g (Table 4). The maximum seed yield per plant was recorded in DWS-296 (13.87 g), which was followed by DWS-41 (12.23 g) and DWS-280 (12.05 g). The minimum seed yield per plant was noticed in DWS-132 (2.76 g). Similarly, seed yield per hectare ranged from 2.34 to 11.74 q (Table 4). The maximum seed yield was found in DWS-296 (11.74 qha<sup>-1</sup>), which was followed by DWS-41 (10.34 qha<sup>-1</sup>) and DWS-280 (10.20 qha<sup>-1</sup>). The minimum seed yield was noticed in DWS-132 (2.34 qha<sup>-1</sup>). This might be due

TABLE 3  
Performance of ashwagandha genotypes for yield attributes

Treatments	Genotypes	Length of main root (cm)	Diameter of main root (cm)	Dry weight of root plant <sup>-1</sup> (g)	Dry root yield plot <sup>-1</sup> (g)	Dry root yield (qha <sup>-1</sup> )
T <sub>1</sub>	DWS-05	14.67	1.61	4.07	223.85	8.61
T <sub>2</sub>	DWS-09	19.65	2.82	7.57	416.35	16.01
T <sub>3</sub>	DWS-22	11.67	1.79	3.34	183.70	7.07
T <sub>4</sub>	DWS-40	11.00	1.76	4.60	253.00	9.73
T <sub>5</sub>	DWS-41	18.86	2.60	6.13	337.15	12.97
T <sub>6</sub>	DWS-132	14.53	1.54	3.95	217.25	8.36
T <sub>7</sub>	DWS-141	17.53	2.08	5.42	298.10	11.47
T <sub>8</sub>	DWS-143	14.00	1.44	4.80	264.00	10.15
T <sub>9</sub>	DWS-144	13.00	1.71	3.59	197.45	7.59
T <sub>10</sub>	DWS-197	15.48	1.64	4.53	249.15	9.58
T <sub>11</sub>	DWS-250	12.58	1.51	4.28	235.40	9.05
T <sub>12</sub>	DWS-252	18.17	2.20	4.57	251.35	9.67
T <sub>13</sub>	DWS-253	12.34	1.58	3.55	195.25	7.51
T <sub>14</sub>	DWS-257	14.95	2.18	4.92	270.60	10.41
T <sub>15</sub>	DWS-258	15.17	1.81	3.96	217.80	8.38
T <sub>16</sub>	DWS-259	12.17	2.16	5.46	300.30	11.55
T <sub>17</sub>	DWS-260	17.33	2.10	5.75	316.25	12.16
T <sub>18</sub>	DWS-262	15.83	1.55	4.16	228.80	8.80
T <sub>19</sub>	DWS-270	12.67	1.95	5.12	281.60	10.83
T <sub>20</sub>	DWS-272	16.00	2.14	4.25	233.75	8.99
T <sub>21</sub>	DWS-279	21.67	2.71	6.80	374.00	14.38
T <sub>22</sub>	DWS-280	16.33	2.38	5.64	310.20	11.93
T <sub>23</sub>	DWS-281	11.50	1.69	4.17	229.35	8.82
T <sub>24</sub>	DWS-284	11.17	1.83	4.49	246.95	9.50
T <sub>25</sub>	DWS-296	16.85	1.59	4.60	253.00	9.73
T <sub>26</sub>	DWS-309	14.58	2.00	4.88	268.40	10.32
T <sub>27</sub>	DWS-315	10.17	1.47	3.89	213.95	8.23
T <sub>28</sub>	DWS-316	15.67	1.85	3.69	202.95	7.81
T <sub>29</sub>	DWS-317	15.00	1.92	4.55	250.25	9.63
T <sub>30</sub>	DWS-319	17.25	2.27	6.00	330.00	12.69
T <sub>31</sub>	Arka Ashwagandha	13.33	2.04	5.15	283.25	10.89
T <sub>32</sub>	Poshita	17.90	1.90	5.30	291.50	11.21
	Mean	14.97	1.93	4.79	263.28	10.13
	S. Em (±)	0.06	0.01	0.02	1.10	0.04
	C.D. @ 5%	0.16	0.02	0.06	3.12	0.12

TABLE 4  
Performance of ashwagandha genotypes for yield characters

Treatments	Genotypes	Fresh weight of per plant (g)	Dry weight of per plant (g)	Seed yield per plant (g)	Seed yield (qha <sup>-1</sup> )
T <sub>1</sub>	DWS-05	99.66	26.67	8.11	6.86
T <sub>2</sub>	DWS-09	133.58	45.93	11.83	10.01
T <sub>3</sub>	DWS-22	57.50	20.90	2.94	2.49
T <sub>4</sub>	DWS-40	63.12	24.76	3.21	2.71
T <sub>5</sub>	DWS-41	131.74	42.73	12.23	10.34
T <sub>6</sub>	DWS-132	45.75	16.79	2.76	2.34
T <sub>7</sub>	DWS-141	70.71	27.42	5.10	4.31
T <sub>8</sub>	DWS-143	90.00	26.10	3.21	2.72
T <sub>9</sub>	DWS-144	52.71	18.86	3.60	3.04
T <sub>10</sub>	DWS-197	104.57	27.37	6.51	5.51
T <sub>11</sub>	DWS-250	78.10	23.54	4.75	4.02
T <sub>12</sub>	DWS-252	121.92	34.04	9.03	7.64
T <sub>13</sub>	DWS-253	70.00	18.91	5.88	4.98
T <sub>14</sub>	DWS-257	97.91	31.47	9.15	7.74
T <sub>15</sub>	DWS-258	76.24	23.74	4.86	4.11
T <sub>16</sub>	DWS-259	94.76	26.97	4.50	3.81
T <sub>17</sub>	DWS-260	99.24	31.41	6.67	5.64
T <sub>18</sub>	DWS-262	62.20	20.71	5.89	4.98
T <sub>19</sub>	DWS-270	114.83	33.87	8.61	7.29
T <sub>20</sub>	DWS-272	87.86	23.03	6.05	5.12
T <sub>21</sub>	DWS-279	132.19	40.80	11.89	10.06
T <sub>22</sub>	DWS-280	116.16	39.46	12.05	10.20
T <sub>23</sub>	DWS-281	81.90	22.59	6.25	5.29
T <sub>24</sub>	DWS-284	92.22	27.91	7.13	6.03
T <sub>25</sub>	DWS-296	109.94	40.18	13.87	11.74
T <sub>26</sub>	DWS-309	71.43	23.50	5.80	4.90
T <sub>27</sub>	DWS-315	50.66	19.42	4.35	3.68
T <sub>28</sub>	DWS-316	83.97	21.31	5.28	4.47
T <sub>29</sub>	DWS-317	88.73	23.81	3.73	3.15
T <sub>30</sub>	DWS-319	126.46	36.36	9.25	7.83
T <sub>31</sub>	Arka Ashwagandha	115.34	31.24	7.16	6.06
T <sub>32</sub>	Poshita	118.22	32.60	6.87	5.81
	Mean	91.86	28.26	6.83	5.78
	S. Em (±)	0.53	0.16	0.47	0.34
	C.D. @ 5%	1.51	0.45	1.32	0.97

to variations in genotypes' reproductive development, which affect seed yield through regulating photosynthesis. The number of berries and branches has a direct impact on seed yield. Patel and Desai (2017) reported similar results in ashwagandha.

Study indicates that DWS-09 showed the highest mean performance in terms of growth and yield characteristics. DWS-279 and DWS-41 were found on par with respective to yield parameters.

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