

## Canopy manipulation to study root yield and quality in ashwagandha (*Withaniasomnifera*)

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**Abstract:** An experiment was conducted during the rabi season of the years 2010-11, 2011-12, 2012-13 and 2013-14 at Medicinal and Aromatic Crop Research Station, A. A. U., Anand, Gujarat to evaluate root yield of ashwagandha under manipulation treatments viz., T<sub>1</sub> - Cutting of 50% canopy of the plants randomly, T<sub>2</sub> - Cutting of 75% canopy of the plants i.e. 75% randomly, T<sub>3</sub> - Stripping of Aerial parts (leaves, flowers and fruits) and T<sub>4</sub> - control. The higher root yield (705 kg ha<sup>-1</sup>) was obtained under treatment T<sub>1</sub> - Cutting of 50% canopy of the plants randomly and also get higher net realization worth Rs. 48456 ha<sup>-1</sup> with BCR (2.33).

**Key words:** Ashwagandha, canopy manipulation, quality, root yield

### INTRODUCTION

Ashwagandha is one of the important medicinal crop of the India. Ashwagandha is a plant of *Solanaceae* family. In Ayurveda, the roots of ashwagandha are known to possess health maintenance and restoration properties, which are similar to ginseng roots, hence it is known as Indian ginseng. It possessed aphrodisiac property. It is an adaptogenic herb and its roots, seeds and leaves are used in ayurvedic and Unani medicines. It is also used for treatment of rheumatic pain, inflammation of joints, nervous disorders, female disorders, hiccup cold, cough, as sedative, ulcers and leprosy etc.

Ashwagandha and its extracts are used in the preparation of herbal tea, powders, tablets and syrups. The main active constituents are alkaloids and steroidal lactones. Ashwagandha root contains 0.4 - 1.2% alkaloids. The important chemical constituents are alkaloids (withanoloids) that are present in roots, leaf and berries. (Atal *et. al* 1961).

Ashwagandha is cultivated over an area of 15000 ha with a production of 60,000 and productivity of 4.00 q/ha in India. It is cultivated mainly in Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Punjab and Uttar Pradesh. In ashwagandha profuse and continues flowering is observed till maturity. In

general continues flowering decrease the root yield and quality. On the basis of preliminary studies, removal of the flowering and aerial part showed better result. Rare information is available on root growth.

### MATERIALS AND METHODS

An experiment was conducted at Medicinal and Aromatic Crop Research Station, Anand Agricultural University, Anand, Gujarat during four consecutive rabi seasons of the years of 2010-11, 2011-12, 2012-13 and 2013-14. The experiment was laid out in randomized block design with six replications. The soil of the experimental field was loamy sand and responded well to manuring and irrigation. It was low in organic carbon and nitrogen, medium in available phosphorus and high in available potassium. The treatment comprising four different canopy manipulation treatments viz., T<sub>1</sub> - Cutting of 50% canopy of the plants randomly, T<sub>2</sub> - Cutting of 75% canopy of the plants randomly, T<sub>3</sub> - Stripping of Aerial parts (leaves, flowers and fruits) and T<sub>4</sub> - control.

The crop was fertilized first at basal dose 10 t FYM ha<sup>-1</sup> and 15-15-0 NPK kg ha<sup>-1</sup>. The first irrigation was given just after sowing and remaining irrigation were

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given as and when required. Five to six irrigations were given in each treatment during the life period of crop. Two hand weeding was carried out in the field with objective to keep the crop free from weed infestation during the early crop growth stage.

## RESULTS AND DISCUSSION

### Branches/plant

Results presented in table 1 showed that differences among the treatments were found significant in 2010-11, 2013-14 and in pooled while it was non-significant during the year 2011-12 and 2012-13. Significantly the maximum branches/plant was recorded under the treatment T<sub>1</sub> (i.e. 4.88 and 4.14) in the 2013-14 and pooled respectively, while during 2010-11 treatment T<sub>2</sub> recorded significantly higher value of branches i.e. 5.13 which was remained at par with T<sub>1</sub> treatment (5.03)

### Dry wt. of biomass q/ha

In case of dry biomass yield results (Table 2) showed non-significant difference during the year 2010-11, 2012-13 and 2013-14. However it was found significant during 2011-12 and pooled analysis. The treatment T<sub>1</sub> recorded significantly higher dry biomass yield i.e 45.89 q/ha and 44.06 q/ha during

the year 2011-12 and pooled analysis, respectively. It was found at par with the treatment T<sub>3</sub>, respectively.

## Yield and quality Parameters

### Dry root length (cm)

Result showed non-significant difference among treatments in all the individual years except pooled (Table 3). Significantly the higher dry root length was noted in the treatment T<sub>2</sub> i.e. 18.54 cm which remained at par with T<sub>1</sub> i.e 17.99 cm (Ghosh *et al.* 1986).

### Dry weight of root (q/ha)

Results of dry root yield (Table 4) was found significant among the treatments in all the years and pooled analysis. Significantly the highest dry weight of root yield was recorded under the treatment T<sub>1</sub> i.e. 7.19, 7.37, 6.69, 6.94 and 7.05 q/ha, respectively followed by the treatment T<sub>2</sub> i.e. 6.76, 6.81, 6.22, 6.46 and 6.56 q/ha, respectively. (Endan *et al.* 2006).

### Withanoloids (%)

Difference among the treatments for withanolide content was found significant in all the year as well as in pooled (Table 5). Significantly the highest

**Table 1**  
Effects of canopy manipulation on branches/plant of ashwagandha

Treatments	2010-11	2011-12	2012-13	2013-14	Pooled
T <sub>1</sub> Cutting of 50% Canopy of plant	5.03	3.01	3.21	4.73	4.03
T <sub>2</sub> Cutting of 75% Canopy of plant	5.13	3.34	3.20	4.88	4.10
T <sub>3</sub> Stripping of aerial parts of plant	3.53	3.26	3.22	3.46	3.37
T <sub>4</sub> Control	3.53	2.41	2.50	2.92	2.84
S.Em ±	0.38	0.30	0.28	0.46	0.19
CD at 5%	1.13	NS	NS	1.40	0.53
CV %	21.34	24.32	22.63	28.41	24.71
Y S.Em ±					0.181
YxTS.Em ±					0.36
YxT CD at 5%					NS

**Table 2**  
Effects of canopy manipulation on dry wt. of biomass (q/ha) of ashwagandha

Treatments	2010-11	2011-12	2012-13	2013-14	Pooled
T <sub>1</sub> Cutting of 50% Canopy of plant	45.62	45.89	44.54	44.06	45.02
T <sub>2</sub> Cutting of 75% Canopy of plant	41.64	41.67	41.43	41.34	42.43
T <sub>3</sub> Stripping of aerial parts of plant	45.62	45.34	44.65	43.87	44.85
T <sub>4</sub> Control	45.84	45.27	44.98	44.14	44.15
S.Em±	1.21	1.05	0.94	0.76	0.47
CD at 5%	NS	3.17	NS	NS	1.33
CV %	6.66	5.80	5.30	4.31	5.59
Y S.Em±					0.50
YxTS.Em±					1.00
YxT CD at 5%					2.84

**Table 3**  
Effects of canopy manipulation on dry root length (cm) of ashwagandha

Treatments	2010-11	2011-12	2012-13	2013-14	Pooled
T <sub>1</sub> Cutting of 50% Canopy of plant	23.03	18.73	15.82	16.45	18.50
T <sub>2</sub> Cutting of 75% Canopy of plant	23.78	16.66	15.72	15.96	18.02
T <sub>3</sub> Stripping of aerial parts of plant	22.59	15.68	14.27	14.52	16.76
T <sub>4</sub> Control	23.58	16.75	14.84	15.00	17.73
<b>S.Em±</b>	0.46	1.01	0.73	0.74	0.37
CD at 5%	NS	NS	NS	NS	1.04
<b>CV %</b>	4.85	14.60	11.72	11.69	10.50
<b>Y S.Em±</b>					0.37
<b>YxTS.Em±</b>					0.75
<b>YxT CD at 5%</b>					NS

**Table 4**  
Effects of canopy manipulation on dry weight of root (kg/ha) of ashwagandha

Treatments	2010-11	2011-12	2012-13	2013-14	Pooled
T <sub>1</sub> Cutting of 50% Canopy of plant	719.4	737.7	669.4	694.7	705.3
T <sub>2</sub> Cutting of 75% Canopy of plant	676.6	681.6	622.4	646.8	656.8
T <sub>3</sub> Stripping of aerial parts of plant	574.4	563.8	551.3	578.0	567.3
T <sub>4</sub> Control	573.3	561.7	540.8	572.9	562.1
<b>S.Em ±</b>	36.09	31.96	24.33	19.89	13.66
CD at 5%	108.76	96.31	73.31	59.95	38.57
<b>CV %</b>	13.80	12.30	9.99	7.81	11.31
<b>Y S.Em ±</b>					14.38
<b>YxTS.Em ±</b>					28.77
<b>YxT CD at 5%</b>					NS

**Table 5**  
Effects of canopy manipulation on withanoloids content (%) of ashwagandha

Treatments	2010-11	2011-12	2012-13	2013-14	Pooled
T <sub>1</sub> Cutting of 50% Canopy of plant	0.64	0.61	0.626	0.65	0.63
T <sub>2</sub> Cutting of 75% Canopy of plant	0.55	0.52	0.62	0.63	0.58
T <sub>3</sub> Stripping of aerial parts of plant	0.59	0.56	0.63	0.64	0.61
T <sub>4</sub> Control	0.55	0.51	0.57	0.58	0.55
<b>S.Em±</b>	0.02	0.01	0.01	0.01	0.009
CD at 5%	0.05	0.03	0.028	0.025	0.030
<b>CV %</b>	7.49	4.89	3.71	3.22	5.03
<b>Y S.Em±</b>					0.006
<b>YxTS.Em±</b>					0.012
<b>YxT CD at 5%</b>					0.034

Withanoloids content was noted in the treatment T<sub>1</sub> i.e. 0.59, 0.56, 0.63, 0.64 and 0.61 % respectively. (Baraiya *et al* 2005).

### Starch (%)

Similar trend was also observed for starch content among the treatments (Table 6). It was found significant in all the year except in pooled.

Significantly the higher starch content was noted in the treatment T<sub>1</sub> i.e. 16.9, 16.90, 23.90 and 24.4% respectively.

### Economies

Treatment T<sub>1</sub> recorded (Table 7) the maximum net realizations Rs. 48456 with BCR 2.33 as compared to other treatments.

**Table 6**  
**Effects of canopy manipulation on starch content (%) of ashwagandha**

Treatments	2010-11	2011-12	2012-13	2013-14	Pooled
T <sub>1</sub> Cutting of 50% Canopy of plant	16.90	16.90	28.32	29.19	22.82
T <sub>2</sub> Cutting of 75% Canopy of plant	12.94	12.40	26.65	27.16	19.78
T <sub>3</sub> Stripping of aerial parts of plant	15.22	15.35	23.63	24.44	19.66
T <sub>4</sub> Control	15.26	15.26	22.71	24.07	19.32
S.Em ±	0.88	0.91	1.19	1.14	1.17
CD at 5%	2.64	2.74	3.57	3.43	NS
CV %	14.25	14.87	11.47	10.62	12.44
Y S.Em ±					0.518
YxTS.Em ±					NS
YxT CD at 5%					2.93

**Table 7**  
**Economics of canopy manipulation on ashwagandha**

Treatments	Dry root yield (kg/ha)	Gross realization (Rs/ha)	Cost of production (Rs/ha)	Net realization (Rs/ha)	BCR
T <sub>1</sub> Cutting of 50% Canopy of plant	705.3	84636	36180	48456	2.33
T <sub>2</sub> Cutting of 75% Canopy of plant	656.8	78816	36846	41970	2.13
T <sub>3</sub> Stripping of aerial parts of plant	567.3	68076	37512	30564	1.81
T <sub>4</sub> Control	562.1	67452	34800	32652	1.93

Note: Dry root 120 Rs./kg

## CONCLUSION

From the foregoing results it is concluded that 50% canopy management at 75 DAS noted the higher fresh as well as dry biomass root yield of ashwagandha.

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