

Studies on nutritional requirement for aswagandh (*Withania somnifera* Dunal) in Shevroy hills of Tamil Nadu, India

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Abstract

Nutritional trials were conducted at Yercaud (Tamil Nadu, India) with the objective of increasing root yield and to determine the optimum nutrition level in aswagandh (*Withania somnifera*). The results indicated that a dose of 40, 60, 20 kg N, P_2O_5 and K_2O /ha (entire dose of P_2O_5 , K_2O and 50 % N basal + 50% N top dressing) recorded the highest dry root yield of 770.37 kg ha⁻¹. There was also improvement in the length of roots, number of root primaries and total withanolides content due to the nutrient application.

Key words : aswagandh, nutrition, *Withania somnifera*.

Aswagandh (*Withania somnifera* Dunal) is widely used for the preparation of indigenous drugs. The leaf and root extract of the plant contain withanolides which exhibit marked activity against various diseases especially, bacterial infections. Among the several alkaloids present in aswagandh, withanine and somniferine are considered to be important and are used in the treatment of carbuncles, ulcer and painful swellings. To determine the yield potential of aswagandh, a nutritional trial was conducted at Shevroy hills of Tamil Nadu, India, which is situated at elevations ranging from 1200 to 1500 m above MSL and the annual rainfall ranging from 1300 to 1600 mm.

The study was carried out at Horticultural

Research Station, Yercaud during 1996 and 1997. The soil is sandy clay loam in texture, with a pH of 5.58 and electrical conductivity of 0.121 d Sm⁻¹. The available nitrogen, phosphorous and potassium contents of the soil were 212 kg, 8.66 kg and 166.66 kg ha⁻¹, respectively. The experimental site was thoroughly ploughed and beds of 7.2 m² size were prepared.

Thirty day old seedlings were planted in the main field with a spacing of 45 cm x 45 cm. The treatments imposed were N (20, 40, 60 kg ha⁻¹), P_2O_5 (60, 80, 100 kg ha⁻¹) and K_2O (20, 40, 60 kg ha⁻¹) and their combinations. The treatments were replicated twice in a factorial randomised block design. At the time of planting, 50% N and entire dose of P_2O_5 and K_2O

Table 1. Effect of various nutrient levels on available soil nutrient content in shoot and root of aswagandh

No.	Treatment (kg ha ⁻¹)			Available soil nutrients (kg ha ⁻¹)			Total nutrients in shoot (%)			Total nutrients in root (%)		
	N	P ₂ O ₅	K ₂ O	Nitrogen	Phosphorus	Potassium	Nitrogen	Phosphorus	Potassium	Nitrogen	Phosphorus	Potassium
T1	20	60	20	222.3	9.16	177.5	1.54	0.70	1.26	1.29	0.63	1.19
T2	20	60	40	321.6	14.0	230.8	2.57	1.19	2.00	2.36	1.14	1.86
T3	20	60	60	315.3	13.8	223.0	2.49	1.14	1.93	2.27	1.11	1.83
T4	20	80	20	301.3	12.3	198.3	2.18	0.99	1.78	2.00	0.92	1.63
T5	20	80	40	294.0	12.8	208.3	2.39	1.02	1.77	2.09	0.99	1.73
T6	20	80	60	288.0	12.5	216.6	2.41	1.09	1.90	2.18	1.04	1.79
T7	20	100	20	293.3	12.3	213.3	2.38	1.03	1.83	2.13	1.00	1.78
T8	20	100	40	283.3	12.5	202.5	2.25	0.92	1.79	2.05	0.90	1.48
T9	20	100	60	275.6	12.6	222.5	2.26	0.98	1.74	2.01	0.94	1.67
T10	40	60	20	370.6	17.1	266.6	3.10	1.46	2.44	2.85	1.32	2.27
T11	40	60	40	355.3	16.1	255.8	3.01	1.39	2.30	2.76	1.24	2.17
T12	40	60	60	352.0	15.5	252.8	2.95	1.32	2.27	2.70	1.22	2.10
T13	40	80	20	343.6	15.0	249.1	2.87	1.30	2.22	2.61	1.20	2.07
T14	40	80	40	336.3	14.3	243.3	2.74	1.29	2.18	2.53	1.19	2.04
T15	40	80	60	333.0	14.1	241.6	2.66	1.25	2.08	2.46	1.18	1.97
T16	40	100	20	325.0	13.5	238.3	2.37	1.22	2.05	2.39	1.13	1.91
T17	40	100	40	287.6	12.8	211.6	2.17	1.00	1.75	1.88	0.96	1.63
T18	40	100	60	266.6	11.8	207.5	2.11	0.92	1.68	1.85	0.88	1.61
T19	60	60	20	263.6	11.1	203.3	2.02	0.94	1.64	1.79	0.89	1.51
T20	60	60	40	253.6	10.6	198.3	1.93	0.92	1.60	1.67	0.84	1.48
T21	60	60	60	237.3	11.3	195.8	1.90	0.91	1.59	1.62	0.87	1.45
T22	60	80	20	254.6	10.5	190.8	1.83	0.86	1.46	1.58	0.82	1.43
T23	60	80	40	249.6	10.5	184.1	1.80	0.85	1.42	1.54	0.79	1.39
T24	60	80	60	244.6	9.5	182.6	1.74	0.86	1.43	1.51	0.86	1.37
T25	60	100	20	246.3	9.3	175.8	1.66	0.78	1.41	1.47	0.77	1.34
T26	60	100	40	242.0	9.0	172.5	1.65	0.79	1.37	1.43	0.73	1.28
T27	60	100	60	239.3	8.8	160.8	1.23	0.77	1.33	1.36	0.71	1.24
T28	Control			174.3	3.1	102.5	1.06	0.38	1.06	1.13	0.57	0.80
S1				258.96	12.3	196.87	2.043	0.969	1.831	2.107	1.026	1.721
S2				326.00	12.8	228.03	2.385	1.142	1.913	2.098	1.041	1.799
S3				273.00	10.8	200.44	1.992	0.833	1.540	1.752	0.761	1.460
				CD	CD	CD	CD	CD	CD	CD	CD	CD
Treatment (T)				4.42	0.87	3.36	0.05	0.04	0.10	0.031	0.020	0.022
Stages (S)				1.44	0.28	1.09	0.01	0.01	0.03	0.008	0.006	0.007
T x S				7.66	1.51	5.87	0.09	0.08	0.18	0.007	0.005	0.039

Table 2. Effect of nutrient application on yield attributes and withanolides content in aswagandh

No.	Treatment (kg ha ⁻¹)			Plant height (cm)	Length of root (cm)	No. of root primaries /plant	Dry root weight (kg ha ⁻¹)	Total withanolides content (%)
	N	P ₂ O ₅	K ₂ O					
T1	20	60	20	18.01	14.00	1.50	439.50	0.23
T2	20	60	40	25.61	23.30	3.00	682.96	0.38
T3	20	60	60	25.30	23.35	2.50	680.98	0.36
T4	20	80	20	22.88	20.00	2.50	647.90	0.29
T5	20	80	40	24.16	22.75	3.00	677.03	0.36
T6	20	80	60	24.78	21.30	3.00	670.61	0.34
T7	20	100	20	24.38	21.05	2.50	667.16	0.33
T8	20	100	40	23.78	20.85	2.50	660.24	0.34
T9	20	100	60	23.16	20.20	2.50	653.82	0.29
T10	40	60	20	30.40	26.00	4.50	770.37	0.49
T11	40	60	40	28.28	25.60	4.00	746.17	0.42
T12	40	60	60	24.48	25.45	4.00	722.96	0.41
T13	40	80	20	27.00	25.15	3.50	705.18	0.38
T14	40	80	40	26.83	25.05	3.50	708.64	0.38
T15	40	80	60	26.45	24.08	3.00	707.16	0.37
T16	40	100	20	26.03	24.75	3.00	694.32	0.38
T17	40	100	40	22.68	19.70	2.00	644.44	0.27
T18	40	100	60	22.41	19.05	2.50	631.60	0.29
T19	60	60	20	21.65	18.70	2.00	627.16	0.28
T20	60	60	40	21.35	18.45	2.00	622.71	0.27
T21	60	60	60	21.43	17.30	2.50	619.25	0.27
T22	60	80	20	21.41	17.20	3.00	611.85	0.27
T23	60	80	40	20.90	17.10	2.50	603.95	0.28
T24	60	80	60	20.70	16.20	2.00	599.01	0.25
T25	60	100	20	20.48	16.15	2.00	594.56	0.26
T26	60	100	40	20.30	15.85	2.00	509.62	0.26
T27	60	100	60	20.08	15.35	2.00	582.71	0.24
T28	Control			9.15	6.20	1.00	118.42	0.10
	S1			8.76				
	S2			24.17				
	S3			36.42				
				CD	CD		CD	CD
	Treatment (T)			0.749	1.02		15.85	0.04
	Stages (S)			0.245	NS		NS	NS
	T x S			1.297	NS		NS	NS

were applied as basal dose. The remaining 50% of N was applied as top dressing 30 days after the basal application. Soil and plant samples (shoot and root) were collected 15 days after basal application (S1), top dressing of nitrogen (S2) and at the time of harvest (S3). The samples were analysed for N, P and K contents (Tandon 1993) and the root samples were analysed for total withanolides content (Mishra 1989). Biometric observations were recorded at the time of harvest.

Significant differences were observed among the treatments both in soil nutrient status and nutrient content in shoots and roots (Table 1). Among the different treatments, application of 40, 60 and 20 kg N, P_2O_5 and K_2O kg ha⁻¹ respectively, recorded the highest amount of available N, P and K contents of 370.6, 17.1 and 266.6 kg ha⁻¹ respectively, followed by the treatment application of 40, 60, 40 kg N, P_2O_5 and K_2O kg ha⁻¹ respectively. The above treatment also recorded the highest total N, P and K contents of 3.10%, 1.45% and 2.24% in shoots and 2.85%, 1.32% and 2.27% in roots.

Among the stages, 15 days after top dressing of nitrogen and potassium fertilizer (S2) recorded the highest amount of available N, P and K_2O contents of 326.0, 12.8 and 228.0 kg ha⁻¹ respectively, followed by 15 days basal application of fertilizers (S1). The above stage also recorded the highest total N, P and K contents of 2.38%, 1.14% and 1.83% in shoots and 2.09%, 1.04% and 1.72% in roots.

Application of nutrients also had significant effects on plant height, yield attributes and root yield (Table 2). The treatment T₁₀ (application of 40, 60, 20

kg N, P_2O_5 and K_2O ha⁻¹) registered the highest plant height (48.90 cm), length of root (26.00 cm/plant), number of root primaries per plant (4.50) and root yield (770.37 kg ha⁻¹).

The increase of available nutrients in soil may have helped the plant to uptake nutrients. A concomitant increase or decrease of nutrients in shoot and root depends upon the availability of nutrient in soil which is essential for better yield (Singh & Sarkar 1986). The interactions between various nutrient levels are known to influence N, P and K contents in both shoot and root (Roy & Seth 1971). These levels are known to increase plant height, number of root primaries and length of roots by way of better availability of nutrients in soil in aswagandh (Nigam *et al.* 1984).

The total withanolides content was also significantly affected by various treatments. The treatment T₁₀ (application of 40, 60, 20 kg N, P_2O_5 and K_2O ha⁻¹) recorded the highest amount of total withanolides (0.47%) in root followed by the treatment T₁₁. In aswagandh, application of nutrients is known to increase withanolides content in root (Nigam *et al.* 1991).

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