

Research Paper

**NUTRIENT UPTAKE BY ASHWAGANDHA (*WITHANIA SOMNIFERA* L.) AS
EFFECTED BY INM AND PANCHAKAVYA**

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Abstract

A field experiment was carried out during *rabi* 2007-08 and *kharif* 2008 to study the effect of integrated nutrient management and *panchakavya* on dry root yield and total uptake by Ashwagandha. Data revealed that the combined application of inorganic, organic and bio fertilizer sources of plant nutrients significantly increased dry root yield and total uptake by Ashwagandha. Application of 150% RDF + castor cake @ 2.5 t ha⁻¹ + bio fertilizers produced significantly higher root yield (348 and 333.kg ha⁻¹ during *rabi* 2007-08 and *kharif* 2008, respectively). Nutrient uptake by shoot, root and total uptake by crop was also significantly higher in the above mentioned treatment.

Key words: Root yield, P and K uptake, INM, *Panchakavya* and Ashwagandha.

INTRODUCTION

Ashwagandha is an important medicinal plant grown in different states of India. The roots of Ashwagandha contains several alkaloids namely withasomnine, steroidal, withaferin A, withaferin B and withanolides. Withaferin is a bacteriostatic and antitumorous agent. The advent of high yielding varieties and increased area under assured irrigation led to a major shift from organic based nutrient application to chemical fertilizers. Consequently their excess and imbalanced application led to soil degradation and reduction in yield. The concept of integrated use of chemical fertilizers and organic manures as emerged an effective approach to sustain the yield of crops and soil productivity. Combined application of organic and inorganic fertilizers affects the nutrient uptake and yield of crop. Hence the present study was planned to study the effect of integrated nutrient management and *panchakavya* on yield and uptake by Ashwagandha.

MATERIALS AND METHODS

The field experiments were conducted at College of Agriculture, Rajendranagar, ANGRAU at Hyderabad on a sandy clay loam soil during *rabi* 2007-08 (I year) and *kharif*

2008 (II year) to study the effect of inorganic fertilizers, organic manures, *panchakavya* and BF on nutrient uptake and dry root yield of Ashwagandha. A composite soil sample was collected in both the years from the experimental site (0-20 cm) before the experiment and analysed. The experimental site during both the years was sandy clay loam in texture, slightly alkaline in reaction (7.60 and 7.54) and non-saline (0.16 and 0.18 dS m⁻¹) in nature. It was low in organic carbon (0.40 and 0.40 per cent) and low in available nitrogen (203 and 200 kg ha⁻¹) and medium in available phosphorous (17.08 and 17.12 kg ha⁻¹) and high in available potassium (287 and 263 kg ha⁻¹). The chemical composition of castor cake, vermi compost, *panchakavya* was presented in table 1. The experiment was laid out in split plot design with three replications. There were totally 16 treatment combinations consisting of 4 main and 4 sub treatments. The main treatments are levels of NPK viz/. 0%, 50%, 100% and 150% NPK and the sub treatments are no manures, castor cake@ 2.5 t ha⁻¹+BF, vermin compost@ 1 t ha⁻¹+BF, *panchakavya* @5% at 30, 60 and 90 DAS+BF.

Preparation of *panchakavya*

Panchakavya is an organic product prepared by mixing five products obtained from cow viz., cow dung (5 kg), cow urine (3 litres), cow milk (2 litres), cow curd (2 litres) and cow ghee (1 litre). In addition to the above products, sugarcane juice (3 litres), tender coconut water (3 litres) and riped banana (1 kg) was also added to get 20 litres of *Panchakavya* stock solution. The mixture is placed in a wide mouthed mud pot and kept under shade. The contents were stirred twice a day for about 20 minutes, both in the morning and in the evening to facilitate aerobic microbial activity. About 10 days after fermentation, it was used for spraying (Natarajan, 2003).

Recommended dose of NPK (60-50-40 Kg ha⁻¹) were applied through urea, single super phosphate and muriate of potash, respectively. Organic manures were applied one week before sowing in the field. The plant samples were analyzed for nutrient concentration by adopting the standard procedures as outlined by Jackson, 1967. The uptake was calculated from nutrient content and dry matter production. The dry root yield was recorded at harvest.

RESULTS AND DISCUSSION

Uptake

The data on P and K uptake by Ashwagandha indicated that the uptake by shoot, root and total uptake was significant due to fertilizer levels, organic manures, *panchakavya* and BF as well as with their interaction. Increased levels of NPK resulted in enhanced uptake of P. Highest total uptake of P by Ashwagandha during *rabi* 2007-08 and *kharif* 2008 was noticed under 150% RDF (15.66 and 11.13 kg ha⁻¹) followed by 100% RDF (12.81 and 9.21 kg ha⁻¹), 50 %RDF (9.44 and 7.41 kg ha⁻¹). The lowest uptake was recorded with no fertilizers (5.91 and 4.81 kg ha⁻¹, respectively). With increase in NPK levels, there was an increase in total uptake of P and K. Higher P and K uptake with increase of NPK levels was due to higher P and K concentrations as well as higher dry matter production. Increase in P uptake by Ashwagandha with 30 kg of P ha⁻¹ (Venkata Reddy *et al.*, 2004), The increase in P uptake with higher application of P resulted from enhanced supply of P to the plant during early growth stages at which it was utilised in larger quantities. Similar findings were reported by Singh and Singh (2004); Chandra Deo and Khandelwal (2009). Among the organic manures, castor cake @ 2.5 t ha⁻¹ registered highest uptake of P. Interaction effects indicated that crop receiving combined application of 150% RDF + castor cake @ 2.5 t ha⁻¹ + BF recorded the highest total P uptake of 21.68 and 15.90 kg ha⁻¹ during both the years respectively (Sandhya

Rani, 2006). Similar results were also reported in respect of K uptake (Nambiar and Ghosh., 1984). Increase in K uptake by onion with 120 -80 kg N - K ha⁻¹ was reported by Ashok Kumar *et al.* (2001),

Combined application of manure and fertilizers exhibited highest nutrient uptake. Improvement of soil physical condition due to addition of organic manures might have resulted in better root growth so that the roots can explore more volumes of soil and ultimately higher uptake of nutrients. In addition, use of bio fertilizers may also favourably influence the root, root growth, crop stand and crop maturity to a certain extent (Mehra 2004, Parthasarathi *et al.*, 1999). The difference in total P and K uptake with different organic amendments in the presence or absence of chemical fertilizers was due to the additional supply of plant nutrients through mineralization of organic manures during crop growth period depending upon their C:N ratio. Lesser C:N ratio resulting in enhanced supply of N, P and K (Sangawan *et al.*, 2002).

Root yield

The results of two years study indicated that the dry root yield was significantly influenced due to both fertilizer levels, organic manures as well as with their interaction. Highest yield of 315 and 311 kg ha⁻¹ was realised under 150% RDF level when compared with other levels. Application of organic manures and *panchakavya* and BF significantly increased the root yield compared to no manures application. Higher yields with castor cake @ 2.5 t ha⁻¹ (328 and 313 kg ha⁻¹) might be due to higher N supply through castor cake and also it may be attributed to increased number of branches, number of leaves and leaf area which have helped in the efficient synthesis and translocation of photosynthates from the source to sink (Sujatha and Krishmappa, 1996). The C : N ratio of castor cake is lower indicating rapid mineralization of N from castor cake.

A highest yield of 348 and 333 kg ha⁻¹ was observed due to integrated use of 150% RDF+ castor cake @ 2.5 t ha⁻¹ + BF compared with other combinations during both the years, respectively. The higher yield due to integration of organic manures could be due to the higher yield attributing characters like root length, girth, higher dry matter production and higher supply of nutrients, favourable physical and biological environment in the soil leading to better root activity and nutrient absorption (Mazumdar *et al.*, 2002 and Somanath *et al.*, 2005). As Ashwagandha is a root crop, improvement of soil physical environment might have helped in better development of roots.

From this study it may concluded that application of inorganic fertilizers, organic manures, *panchakavya* and bio fertilizers significantly increased the root yield and nutrient uptake. Conjunctive use of 150% RDF + castor cake @ 2.5 t ha⁻¹ + BF recorded the highest dry root yield, total P and K uptake by Ashwagandha.

Table 1: Chemacal composition of castor cake, vermi-compost and *Panchakavya*

Nutrient composition	Castor cake	Vermi-compost	<i>Panchakavya</i>
N (%)	5	1.5	0.44
P (%)	2.2	1	0.41
K (%)	2	0.5	1.02
S (mg kg ⁻¹)	23	33	30
Zn (mg kg ⁻¹)	76	64	28
Fe (mg kg ⁻¹)	92	52	87
Mn (mg kg ⁻¹)	45	39	20
Cu (mg kg ⁻¹)	40	57	17

Table 2: Effect of inorganic fertilisers, organic manures, *panchakavya* and bio fertilisers on dry root yield (kg ha⁻¹) of Ashwagandha at harvest during *rabi* 2007-08 (I year) and *kharif* 2008 (II year)

Treatments	<i>Rabi</i> 2007-08 (I year)					<i>Kharif</i> 2008 (II year)				
	Flowering					Harvest				
Sub	S ₁	S ₂	S ₃	S ₄	Mean	S ₁	S ₂	S ₃	S ₄	Mean
Main	No manures	castor cake @ 2.5 t ha ⁻¹ + BF*	vermi-compost @ 1 t ha ⁻¹ + BF	<i>panchakavya</i> @ 5% foliar spray + BF		No manures	castor cake @ 2.5 t ha ⁻¹ + BF*	vermi-compost @ 1 t ha ⁻¹ + BF	<i>panchakavya</i> @ 5% foliar spray + BF	
M ₁ -0% NPK	248	298	280	267	273	242	285	279	277	271
M ₂ -50% NPK	265	320	294	277	289	269	308	294	283	289
M ₃ -100% NPK**	279	344	315	289	307	281	325	310	300	304
M ₄ -150% NPK	287	348	317	305	315	287	333	318	308	311
Mean	273	328	302	285		272	313	301	292	

C.D SE(M)

Main 5.47 2.79
Sub 5.03 2.56
Main at same or different level of sub 10.73 5.47

C.D SE(M)

3.92 2.00
4.50 2.30
8.14 4.15

BF* - Bio fertilisers (Azospirillum + Phosphorous Solubilizing Bacteria)

100% NPK** = 60 - 50 - 40 kg NPK ha⁻¹

Table 3: Effect of inorganic fertilizers. Organic manures, panchakavya and BF on P uptake (kg ha^{-1})
by *Ashwagandha* during *rabi* 2007-08 (I year) and *kharif* 2008 (II year)

Treatments		Rabi 2007-08 (I year)					Kharif 2008 (II year)				
		Shoot uptake					Shoot uptake				
Main	Sub	S ₁	S ₂	S ₃	S ₄	Mean	S ₁	S ₂	S ₃	S ₄	Mean
		No manures	castor cake @ 2.5 t ha^{-1} + BF*	vermi-compost @ 1 t ha^{-1} + BF	panchakavya @ 5% foliar spray + BF		No manures	castor cake @ 2.5 t ha^{-1} + BF*	vermi-compost @ 1 t ha^{-1} + BF	panchakavya @ 5% foliar spray + BF	
M ₁ -0% NPK		3.80	7.04	5.66	4.89	5.35	2.90	5.47	4.58	3.95	4.22
M ₂ -50% NPK		5.06	13.98	8.86	7.22	8.78	4.15	10.01	7.18	5.65	6.75
M ₃ -100% NPK**		6.65	18.25	12.65	10.69	12.06	5.48	12.21	8.38	7.58	8.41
M ₄ -150% NPK		8.67	20.69	16.97	12.99	14.83	6.81	14.86	11.45	8.07	10.30
Mean		6.04	14.99	11.04	8.95		4.84	10.64	7.90	6.31	
						SE(M)					
Main						0.198					
Sub						0.171					
Main at same or different level of sub						0.356					
		Root uptake					Root uptake				
M ₁ -0% NPK		0.45	0.70	0.55	0.55	0.56	0.47	0.67	0.62	0.58	0.59
M ₂ -50% NPK		0.55	0.83	0.67	0.60	0.66	0.53	0.80	0.72	0.61	0.67
M ₃ -100% NPK**		0.62	0.92	0.80	0.67	0.75	0.57	0.98	0.83	0.81	0.80
M ₄ -150% NPK		0.67	0.99	0.88	0.78	0.83	0.62	1.04	0.91	0.75	0.83
Mean		0.57	0.86	0.72	0.65		0.55	0.87	0.77	0.69	

				SE(M)	C.D.					SE(M)	C.D.
Main				0.034	0.092					0.018	0.058
Sub				0.033	0.089					0.020	0.042
Main at same or different level of sub				0.066	0.178					0.037	0.096
	Total uptake						Total uptake				
M₁-0% NPK	4.26	7.73	6.21	5.44	5.91		3.37	6.14	5.20	4.52	4.81
M₂-50% NPK	5.61	14.81	9.53	7.82	9.44		4.68	10.81	7.90	6.26	7.41
M₃-100% NPK**	7.26	19.17	13.45	11.36	12.81		6.05	13.19	9.21	8.39	9.21
M₄-150% NPK	9.34	21.68	17.85	13.77	15.66		7.43	15.90	12.35	8.83	11.13
Mean	6.62	15.85	11.76	9.60			5.38	11.51	8.67	7.00	
				SE(M)	C.D.					SE(M)	C.D.
Main				0.312	0.854					0.328	0.642
Sub				0.261	0.594					0.288	0.566
Main at same or different level of sub				0.445	1.332					0.638	1.241

Table 4: Effect of inorganic fertilizers. Organic manures, panchakavya and BF on K uptake (kg ha^{-1}) by Ashwagandha during *rabi* 2007-08 (I year) and *kharif* 2008 (II year)

Treatments		Rabi 2004-05 (I year)					Kharif 2008 (II year)						
		Shoot uptake					Shoot uptake						
Main	Sub	S ₁	S ₂	S ₃	S ₄	Mean	S ₁	S ₂	S ₃	S ₄	Mean		
	No manures	castor cake @ 2.5 t ha ⁻¹ + BF*	vermi-compost @ 1 t ha ⁻¹ + BF	panchakavya @ 5% foliar spray + BF	No manures		castor cake @ 2.5 t ha ⁻¹ + BF*	vermi-compost @ 1 t ha ⁻¹ + BF	panchakavya @ 5% foliar spray + BF				
M ₁ -0% NPK		40.2	72.6	64.8	52.0	57.4	26.8	50.0	45.5	34.1	39.1		
M ₂ -50% NPK		54.2	114.4	88.1	67.0	80.9	34.8	79.6	62.2	48.2	56.2		
M ₃ -100% NPK**		67.1	130.1	96.4	90.3	96.0	45.0	90.7	69.2	62.6	66.9		
M ₄ -150% NPK		79.6	151.5	126.4	97.4	113.7	53.0	104.1	89.2	66.1	78.1		
Mean		60.3	117.2	93.9	76.7		39.9	81.1	66.5	52.8			
SE(M)						C.D.	SE(M)					C.D.	
Main						0.67	2.30	0.85					2.94
Sub						0.97	2.84	0.71					2.07
Main at same or different level of sub						1.81	5.43	1.49					4.62
		Root uptake					Root uptake						
M ₁ -0% NPK		4.95	6.70	6.06	5.54	5.81	4.11	5.79	5.10	4.83	4.96		
M ₂ -50% NPK		5.02	7.43	6.24	5.77	6.11	4.47	6.85	6.13	5.51	5.74		
M ₃ -100% NPK**		5.53	8.19	6.96	6.19	6.72	5.05	7.48	6.68	6.12	6.33		
M ₄ -150% NPK		6.09	8.51	7.28	6.60	7.12	5.73	8.11	7.19	6.61	6.91		
Mean		5.40	7.71	6.63	6.02		4.84	7.06	6.28	5.77			
SE(M)						C.D.	SE(M)					C.D.	

Main	0.20	0.59					0.05	0.09		
Sub	0.19	0.57					0.05	0.10		
Main at same or different level of sub	0.38	1.16					0.10	0.19		
	Total uptake					Total uptake				
M ₁ -0% NPK	45.19	79.34	70.82	57.50	63.21	30.93	55.81	50.63	38.95	44.08
M ₂ -50% NPK	59.18	121.85	94.39	72.80	87.05	39.31	86.42	68.32	53.73	61.94
M ₃ -100% NPK**	72.64	138.26	103.40	96.51	102.7	50.03	98.18	75.86	68.76	73.21
M ₄ -150% NPK	85.65	160.00	133.69	104.05	120.8	58.73	112.23	96.38	72.66	85.00
Mean	65.66	124.86	100.57	82.71		44.75	88.16	72.80	58.53	
	SE(M) C.D.					SE(M) C.D.				
Main	0.918 2.978					1.047 2.444				
Sub	1.023 2.874					0.938 2.042				
Main at same or different level of sub	1.806 5.682					1.898 4.699				

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