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DRYMATTER PRODUCTION, ROOT CHARACTERS AND SEED YIELD OF ASHWAGANDHA (*Withania somnifera* L.) AS INFLUENCED BY PANCHAKAVYA

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ABSTRACT
The effect of *panchakavya* prepared from cow (*PK-C*) and buffalo (PK-B) products on dry root yield, root length, girth, grading of roots and alkaloid content in leaves and roots was studied during *rabi* 2007-08 and *kharif* 2008 at College of Agriculture, Rajendranagar, ANGRAU, Hyderabad. The results revealed that the highest dry matter production (2322 and 2238 kg ha^{-1} during *rabi* 2007-08 and *kharif* 2008, respectively), root yield (290 and 280 kg ha-1 during *rabi* 2007-8 and *kharif* 2008, respectively) was recorded with *PK-C*@5% - 4 sprays. The seed yield was significantly influenced by *PK-C* and *PK-B*. No significant effect on root length, girth, alkaloid content with different concentrations and sources of *panchakavya* during *rabi* 2007-08 and *kharif* 2008..

KEY WORDS: *Panchagavya,* Ashwagandha, Root and seed yield, Root grading and quality.

INTRODUCTION

Contineous use of inorganic fertilizers without organic manures cause sustainable soil productivity by reducing microbial activity and affecting soil health apart from causing nutritional imbalance in soil. Application of organic products along with chemical fertilizers improves productivity of soil and provides good soil health by reducing the consumption of chemical fertilizers and also increases in the quality of crop. *Panchakavya* is an important organic product. Spraying of *Panchakavya* @ 3% on plants was found to improve the growth, yield and quality of different crops considerably (Natarajan, 2003). The purpose of foliar spray is not to replace the soil fertilization, supplying the major and micro nutrients, stimulating growth promoting hormones and enhances the growth and yield potential of crops (Kirankumar,2013). Keeping in view the present study was taken up to study the effect of *Panchakavya* on root characters, root and seed yield of Ashwagandha.

MATERIALS & METHODS

The present investigation was carried out at College Farm, College of Agriculture, Rajendranagar, ANGRAU on a sandy clay loam soil during *rabi* 2007-08 (I year) and *kharif* 2008 (II year) to study the effect of *Panchagavya* on drymatter production, yield characteristics, alkaloid content in leaf and root, seed yield of Ashwagandha. The experimental site is located at Latitude of $17^{0}19^{1}39^{11}$ N and Longitude of $78^{0}24^{1}09^{11}$ E and at an altitude of 568.3 m above mean sea level. The experiment was laid out in Randomized Block Design with 12 treatments.
Treatmental details:

T1 – *Panchagavya* (cow) spray @ 3 per cent with 3 sprays at 30, 60 and 90 DAS
T2 – *Panchagavya* (cow) spray @ 5 per cent with 3 sprays at 30, 60 and 90 DAS
T3 –*Panchagavya* (cow) spray @ 3 per cent with 4 sprays at 20, 40, 60 and 80 DAS
T4 – *Panchagavya* (cow) spray @ 5 per cent with 4 sprays at 20, 40, 60 and 80 DAS
T5 – *Panchagavya* (buffalo) spray @ 3 per cent with 3 sprays at 30, 60 and 90 DAS
T6 – *Panchagavya* (buffalo) spray @ 5 per cent with 3 sprays at 30, 60 and 90 DAS
T7 – *Panchagavya* (buffalo) spray @ 3 per cent with 4 sprays at 20,40,60 and 80 DAS
T8 – *Panchagavya* (buffalo) spray @ 5 per cent with 4 sprays at 20,40,60 and 80 DAS
T9 – *Panchagavya* (cow) spray @ 9 per cent to soil as basal application
T10 – *Panchagavya* (cow) spray @ 15 per cent to soil as basal application
T11 – *Panchagavya* (buffalo) spray @ 9 per cent to soil as basal application
T12 – *Panchagavya* (buffalo) spray @ 15 per cent to soil as basal application

The recommended nitrogen was applied in three equal splits at basal, 30 DAS and at flowering stage through urea. Entire phosphorous was applied as basal through single superphosphate. Potassium was applied in two equal splits at basal and at flowering stage through muriate of potash. Bio fertilizers were applied by mixing each 5 kg of *Azospirillum* and PSB (Phosphorous Solubilising Bacteria) in 50 kg FYM ha^{-1} and applied in two splits at basal and at 30 DAS in crop rows. Spraying of *Panchagavya: Panchagavya* made from cows and buffalo products was sprayed as per treatments at different days after sowing in different concentrations.

Preparation of *Panchagavya*

Panchagavya 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 *panchagavya* 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). Nutrient composition of panchakavya was presented in below.

Nutrient composition	*Panchakavya* made from cow products	*Panchakavya* made from buffalo products
N (%)	0.44	0.3
P (%)	0.41	0.35
K (%)	1.02	1.08
S (mg kg^{-1})	30	32
Zn (mg kg^{-1})	28	24
Fe (mg kg^{-1})	87	76
Mn (mg kg^{-1})	20	22
Cu (mg kg^{-1})	17	20
Yeast (CFU/ ml)	38 x 10^4	32x10^4
Actinomycetes (CFU/ml)	4 x 10^2	47x10^2
Lactic acid bacteria (CFU/ml)	26 x 10^6	24x10^6

Intercultural operations were same to all experimental plors. The plant samples were collected at flowering and harvest for recordind the drymatter production, alkaloid content in leaves. The seed yield was recorded after harvest.

RESULTS & DISCUSSION

The data with regard to total dry matter production, rooy yield, root lemgth and root girth during *rabi* 2007 – 2008 and *kharif* 2008 are presented in table 1. Dry matter production was significantly influenced by all the treatments at both stages of crop growth. At flowering among all the treatments, application of *panchakavya* made from cow products (*PK - C*) @ 5% - 4 sprays recorded significantly the highest dry matter production (1236 and 1152 kg ha^{-1} during *rabi* 2007-2008 and *kharif* 2008, respectively) followed by *panchakavya* made from buffalo products (*PK - B*) @ 5% - 4 sprays in both the years.

TABLE 1: Effect of panchakavya (made from cow and buffalo products) on total dry matter production, root characters and yield of Ashwagandha during rabi 2007 - 2008 (I year) and kharif 2008 (II year)

Treatments		Total drymatter production (kg ha^{-1})				Dry root yield (kg ha^{-1})				Root length (cm)		Root girth (cm)	
		Rabi 2007-08		*Kharif* 2008		*Rabi* 2007-08		*Kharif* 2008		*Rabi*	*Kharif*	*Rabi*	*Kharif*
		Flowering	Harvest	Flowering	Harvest	Flowering	Harvest	Flowering	Harvest	2007-08	2008	2007-08	2008
T_1	*PK* - C @ 3% - 3 sprays	1039	2087	1042	2008	80	241	85	230	17.50	1.00	15.60	0.90
T_2	*PK* - C @ 5% - 3 sprays	1166	2256	1101	2182	104	271	104	258	14.80	1.10	11.92	0.90
T_3	*PK* - C @ 3% - 4 sprays	1098	2135	1089	2085	84	259	89	234	16.84	1.30	13.74	0.60
T_4	*PK* - C @ 5% - 4 sprays	1236	2322	1152	2238	108	290	112	280	15.75	1.40	14.45	1.20
T_5	*PK* - B @ 3% - 3 sprays	1006	2052	1024	1975	74	223	80	220	13.98	1.10	15.40	1.10
T_6	*PK* - B @ 5% - 3 sprays	1112	2226	1072	2156	91	263	101	255	14.85	1.30	13.25	1.00
T_7	*PK* - B @ 3% - 4 sprays	1053	2100	1055	2032	87	235	89	226	15.20	0.90	13.94	1.10
T_8	*PK* - B @ 5% - 4 sprays	1204	2309	1139	2205	102	286	107	274	15.50	1.10	14.94	0.90
T_9	*PK* - C @ 9% to soil	1086	2143	953	1932	82	230	73	226	16.35	1.30	15.64	1.00
T_{10}	*PK* - C @ 15% to soil	1193	2194	1136	2128	94	282	106	265	17.10	0.80	12.95	0.80
T_{11}	*PK* - B @ 9% to soil	1075	2108	938	1906	80	220	70	215	19.45	0.90	16.27	1.00
T_{12}	*PK* - B @ 15% to soil	1132	2175	1030	2056	94	253	91	248	18.52	0.90	15.60	0.90
	C.D (P = 0.05)	18.08	32.25	20.47	42.26	3.5	8.3	3.7	10.1	1.80	NS	1.45	NS
	SE m	7.86	13.46	6.18	16.42	1.4	3.1	1.6	3.8	0.92	0.86	0.74	0.62

The lowest was noticed with *PK - B* @ 3% - 3 sprays during *rabi* 2007 – 2008 and with *PK* - B @ 9% to soil in *kharif* 2008. At harvest in both the years, application of *PK - C* @ 5% - 4 sprays showed the highest dry matter production (2322 and 2238 kg ha^{-1} during *rabi* 2007-2008 and *kharif* 2008, respectively) while it was at par with *PK - B* @ 5% - 4 sprays. This might be due to quick absorption of nitrogen which was received by plants through *panchakavya* + inorganic fertilizers. Influence of nitrogen in promoting vegetative growth is a well established fact that nitrogen encompasses plant height through its effect on rapid meristematic activity. By foliar spray of *panchakavya*, the absorption of nutrients was higher thus increasing quick growth and increased plant height as well as other growth attributes which helps in increase of dry matter production. A similar result in increase of dry matter production with foliar spray of panchakavya was reported by Rajesh bhalla *et al.*, (2006) in gladiolus, Yadav and Lourduraj (2006) in rice with 3% at 4 foliar sprays of *panchakavya.*

The dry root yield was significantly influenced by different treatments of *panchakavya* at both stages of

Ashwagandha in both the years. During both the years at harvest, the highest dry root yield (290 and 280 kg ha^{-1} during *rabi* 2007-2008 and *kharif* 2008, respectively)had recorded with *PK* - C @ 5% - 4 sprays while it was on par with *PK*- B @ 5% - 4 sprays. The higher root yield recorded with *panchakavya*-C @ 5% - 4sprays which was on par with *panchakavya*-B @ 5% - 4sprays along with inorganic fertilizers. The presence of coconut water in *panchakavya* which contains kinetin (cytokinin) promotes cell division and cell enhancement thus the root length and leaf expansion increased. Similar results were observed by Abussamed (1999) in gladiolus.. The proportion and activity of beneficial microbes would be at the higher rate in *panchakavya* - C which helps in synthesis of growth promoting substances that might have increased the yields (Watteeduzzama *et al.,* 2007). The cow urine is known for the presence of growth promoting auxins like IAA (Zhang 2000). Transport of photosynthates through phloem from source to sink is directly under the control of cytokinns. Therefore, more root weight with *panchakavya* - C @ 5% - 4 sprays might have been recorded. Similar results were reported by Ramachandrudu and Thangam (2007) in gladiolus. The positive effect of *panchakavya* might be mainly due to its action as stimulant rather than supply of plant nutrients (Somasundaram *et al.,* (2007). Different treatments of *panchakavya* showed non significant effect on root length of Ashwagandha. The highest was noticed with *PK*- B @ 9% to soil in both the years (19.45 and 16.27 cm, respectively) and the lowest was recorded with *PK*- B @ 3% - 3 sprays during *rabi* 2007-2008 and with *PK*- C @ 5% - 3 sprays in *kharif* 2008. Waheeduzzama *et al.* (2007). All the treatments exerted non significant effect on root girth of Ashwagandha. The lowest was recorded with *PK-C* @ 9% to soil (T_9) in *rabi* 2007-2008 and with *PK*- C @ 3% - 4 sprays (T_3) during *kharif* 2008 and the highest was noticed with *PK*- C @ 5% -4 sprays in both the years (1.40 and 1.20 cm, respectively). The data regard to grading of roots during *rabi* 2007-2008 and *kharif* 2008 are presented in table 2.

TABLE 2: Effect of panchakavya (made from cow and buffalo products) on total alkaloid content (%) in leaf and root of Ashwagandha duringrabi 2007-08 (I year) and kharif 2008 (II year)

Treatments	*Rabi* 2007-2008		*Kharif* 2008		*Rabi* 2007-2008	*Kharif* 2008
	Alkaloid content in leaf				Alkaloid content in root	
	Flowering	Harvest	Flowering	Harvest	Harvest	Harvest
T_1 *PK* - C @ 3% - 3 sprays	0.14	0.16	0.18	0.20	0.22	0.18
T_2 *PK* - C @ 5% - 3 sprays	0.14	0.14	0.14	0.18	0.23	0.20
T_3 *PK* - C @ 3% - 4 sprays	0.17	0.14	0.14	0.15	0.21	0.18
T_4 *PK* - C @ 5% - 4 sprays	0.15	0.15	0.19	0.19	0.21	0.20
T_5 *PK* - B @ 3% - 3 sprays	0.13	0.18	0.15	0.18	0.20	0.19
T_6 *PK* - B @ 5% - 3 sprays	0.16	0.18	0.14	0.20	0.21	0.20
T_7 *PK* - B @ 3% - 4 sprays	0.16	0.17	0.13	0.18	0.19	0.17
T_8 *PK* - B @ 5% - 4 sprays	0.14	0.16	0.12	0.16	0.20	0.21
T_9 *PK* - C @ 9% to soil	0.14	0.18	0.18	0.18	0.18	0.19
T_{10} *PK* - C @ 15% to soil	0.13	0.17	0.16	0.20	0.21	0.19
T_{11} *PK* - B @ 9% to soil	0.13	0.17	0.14	0.17	0.20	0.18
T_{12} *PK* - B @ 15% to soil	0.15	0.18	0.17	0.20	0.20	0.20
C.D (P = 0.05)	NS	NS	NS	NS	NS	NS
S Em	0.020	0.02	0.043	0.057	0.017	0.01

TABLE 3: Effect of panchakavya (made from cow and buffalo products) on grading of roots of Ashwagandhaduring rabi 2007 - 2008 and kharif 2008

Treatments	Grading of roots* (%)									
	Rabi 2007 - 2008					*kharif* 2008				
	A	B	C	D	E	A	B	C	D	E
T_1 - *PK*-C @ 3% - 3 sprays	6	38	24	20	12	12	34	30	18	6
T_2 - *PK*-C @ 5% - 3 sprays	8	25	30	25	12	8	40	28	10	14
T_3 - *PK*-C @ 3% - 4 sprays	4	14	18	36	28	18	28	20	15	9
T_4 - *PK*-C @ 5% - 4 sprays	10	16	20	34	20	4	16	20	35	25
T_5 - *PK*-B @ 3% - 3 sprays	14	36	22	10	18	8	20	28	32	12
T_6 - *PK*-B @ 5% - 3 sprays	6	12	10	40	32	10	28	30	17	15
T_7 - *PK*-B @ 3% - 4 sprays	10	32	24	20	14	6	18	23	35	18
T_8 - *PK*-B @ 5% - 4 sprays	5	15	23	30	27	15	32	23	20	12
T_9 - *PK*-C @ 9% to soil	4	12	18	36	30	6	30	37	18	9
T_{10} - *PK*-C @ 15% to soil	12	28	30	24	6	20	12	35	25	8
T_{11} - *PK*-B @ 9% to soil	16	22	36	18	8	12	24	34	20	10
T_{12} - *PK*-B @ 15% to soil	10	30	32	10	18	10	35	28	18	9

*Root grade based on thickness in mm: A = <8; B = > 8-10; C => 10-12; D = > 12-13; E = > 13

During *rabi* 2007-2008 among all the treatments, the maximum % of 'A' grade roots (16%) were obtained from *PK - B* @ 9% to soil (Ajay *et al.* (2005) followed by *PK*- B @ 3% - 3 sprays (14%) whereas *PK*- C @ 3% - 3 sprays recorded highest % of 'B' grade roots (38%). Application of *PK - B* @ 9% to soil resulted the maximum 'C' grade (36%) roots. The highest % of 'D' and 'E' grade roots were recorded with *PK*- B @ 5% - 3 sprays (40% and 38%, respectively). During *kharif* 2008 among all the treatments, application of *PK - C* @ 15% to soil recorded

highest % of 'A' grade tubers (20%) (Rajesh Bhalla *et al.*, (2006). The 'B' grade roots were highest with application of *PK*- C @ 5% - 3 sprays (40%). The soil application of *PK - C* @ 9% showed highest grade 'C' roots (37%). The treatments *PK*- C @ 5% - 4sprays and *PK*- B @ 3% - 4sprays showed maximum 'D' grade roots (35%). Application of *PK*- C @ 5% - 4sprays showed highest % of 'E' grade roots (25%). The data regards to alkaloid content in leaf at flowering and harvest and in root at harvest during *rabi* 2007-2008 and *kharif* 2008 are presented in table 2. Different treatments of *panchakavya* showed non significant effect on alkaloid content in leaf and root of Ashwagandha in both the years. During *rabi* 2007-2008, at flowering, the highest alkaloid content in leaf was resulted from *PK* - C @ 3% - 4 sprays (0.17%). Application of *PK* - C @ 15% to soil showed highest alkaloid content (0.20%) in leaf and the lowest was noticed from *PK* - B @ 5% - 4 sprays (0.13%) at harvest. In *kharif* 2008, the maximum alkaloid content at flowering was recorded with *PK* - C @ 3% - 4 sprays (0.19%). However, at harvest the treatments *PK* - C @ 3% - 3 sprays, *PK* - B@ 5% - 3 sprays, *PK* - C @ 15% to soil and *PK* - B @ 15% to soil showed the highest alkaloid content (0.20%). Different treatments of *panchakavya* showed non significant effect on root alkaloid content in *rabi* 2007-08 and *kharif* 2008.. During *rabi* 2007-08, the highest was noticed with *PK* - C @ 5% - 3 sprays (0.23%) (T_2). During *kharif* 2008 it had ranged from 0.17% with *PK* - B @ 3% - 4 sprays (T_7) to 0.21% with *PK* - B @ 5% - 4 sprays (T_8). The alkaloid content in Ashwagandha may be a genetical character. *Panchakavya* was known to contain plant growth stimulants which can enhance the biological efficiency of crops and the quality of the produce (Pathak and Ram, 2002). The seed yield was significantly influenced by different treatments of *panchakavya* in both the years (Table 4). During *rabi* 2007-2008, significantly the highest seed yield had recorded with *PK- C* @ 5% - 4 sprays (818 kg ha^{-1}) followed by *PK - C* @ 15% to soil. The lowest was noticed with *PK - B* @ 3% - 3 sprays (669 kg ha^{-1}). While in *Kharif* 2008 application of *PK - C* @15% to soil showed the highest seed yield (671 kg ha^{-1}) and it was on par with *PK - C* @ 5% - 4 sprays (668 kg ha^{-1}). This might be due to better assimilation of nitrogen which helps to retain number of flowers on the plants which increases the number of developing fruits and produce more seed. The results of the present investigation showed that DMP and root yield was highest with foliar application of *panchakavya* than soil application. *Panchakavya* sprayed at more intervals (4 sprays) with higher concentration (5 %) recorded highest root and seed tield than spraying in 3 intervals with 3% concentration.

TABLE 4: Effect of Panchakavya on seed yield (kg ha-1) of Ashwagandha

Treatments		seed yield (kg ha^{-1})	
		Rabi 2007-2008	*Kharif* 2008
T_1	*PK* - C @ 3% - 3 sprays	804	508
T_2	*PK* - C @ 5% - 3 sprays	880	557
T_3	*PK* - C @ 3% - 4 sprays	829	518
T_4	*PK* - C @ 5% - 4 sprays	818	560
T_5	*PK* - B @ 3% - 3 sprays	769	549
T_6	*PK* - B @ 5% - 3 sprays	775	597
T_7	*PK* - B @ 3% - 4 sprays	827	434
T_8	*PK* - B @ 5% - 4 sprays	873	542
T_9	*PK* - C @ 9% to soil	796	448
T_{10}	*PK* - C @ 15% to soil	888	571
T_{11}	*PK* - B @ 9% to soil	854	552
T_{12}	*PK* - B @ 15% to soil	838	524
C.D (P = 0.05)		11.34	9.76
S Em		4.16	3.80

PK – C Panchakavya made from cow products 3 sprays at 30 at panchakavya applied to soil as basal
PK – B Panchakavya made from buffalo products 4 sprays at 20, 40, 60 and 80 DAS

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