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Research article

EFFECT OF *PANCHAKAVYA* ON SOIL ENZYME ACTIVITY IN ASHWAGANDHA

B.Vajantha*, M.Umadevi, M.C.Patnaik and M.Rajkumar

Dept. of Soil Science and Agricultural Chemistry, College of Agriculture, Rajendranagar, ANGRAU, Hyderabad-500030

*Author for correspondence, E Mail: vajantha@gmail.com, Scientist (Soil Science), Perumallapalle-517505, Tirupathi, Andhra Pradesh

ABSTRACT : The study was carried out to investigate the effect of *panchakavya* made from cow (*PK*-C) and buffalo (*PK*-B) products on urease and dehydrogenase activity and root yield of Ashwagandha and it revealed that soil application of *PK*-C @ 15% recorded the highest urease activity at both the stages of crop (85.24, 44.56 at flowering and harvest during *rabi* 2007-08 and 81.07, 35.50 µg of NH_4^+ released g^{-1} soil h^{-1} at flowering and harvest in *kharif* 2008). The highest dehydrogenase activity also noticed in the same treatment (91.05, 49.05 µg of TPF g^{-1} soil day^{-1} at flowering, harvest during *rabi* 2007-08 and 81.00,, 39.64 µg of TPF g^{-1} soil day^{-1} at flowering, harvest in *kharif* 2008) during both the years. The highest dry root yield was recorded with *PK* - C @ 5% - 4 sprays (290 and 280 kg ha^{-1} during both the years, respectively)

Keywords: Ashwagandha, *panchakavya* made from cow and buffalo products, enzyme activity and dry root yield

INTRODUCTION

Modern farming required large inputs of chemical fertilizers and stimulants to increase yield. To maintain yield in deteriorating soil, increasing doses of modern chemical inputs have to be used. In view of reducing cost of fertilizers and their hazardious effects on environment, there is growing awareness in the farming community about alternate agriculture system. This alternate system is known as biological farming or organic farming. Among the organic farming systems, biodynamic agriculture, panchagavya, dasagavya, aroma farming techniques are prevalent in our country. *Panchgavya* is a specisl prepararion made from five cow products. Ashwagandha is an important medicinal plant grown in different states of India. The roots of Ashwagandha contains several alkaloids namely with a somnine, steroidal, with a ferin A, with a ferin B and withanolides. With a ferin is a bacteriostatic and antitumerous agent. *Panchakavya* is one of the important organic product which showed considerable effect on soil enzymes. The enzyme activity is considered as an index of microbial activity. Enzymes in soil are biologically significant as they participate in

the transformation, cycling of mineral nutrients and influence their availability to plants. The activity of soil enzymes are influenced by the nature, age of crop, addition of fertilisers and manures. The activity of soil enzymes are influenced by the nature, age of crop, addition of fertilisers and manures. The present investigation was undertaken to study the effect of *panchakavya* on urease, dehydrogenase activity in soil and dry root yield of Ashwagandha at harvest.

MATERIALS AND METHODS

Two field experiments were conducted to study the effect of different sources of *Panchakavya* on enzymatic activity and dry root yield of Ashwagandha 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). 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 *panchakavya* made from cow and buffalo products was presented in table 1. The experiment was laid out in simple RBD design with 12 treatments and replicated thrice.

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 *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). *PK*-B was prepared similarly with buffalo products.

Recommended dose of NPK (60-50-40 Kg ha^{-1}) were applied to all plots through urea, single super phosphate and muriate of potash, respectively. Representative soil samples were collected from each plot at flowering and harvest in both the years for enzyme analysis. Urease activity was analysed as per the procedure given by Tabatabai and Bremner (1972). Dehydrogenase activity was determined by the procedure given by Casida *et al.*, (1964). The dry root yield was recorded at harvest.

RESULTS AND DISCUSSION

Dry root yield

The dry root yield was significantly influenced by different treatments of *panchakavya* at both stages of Ashwagandha during both the years. During *rabi* 2007-08 and *Kharif* 2008, the highest dry root yield had recorded with *PK* - C @ 5% - 4 sprays (290 and 280 kg ha^{-1}, respectively) while it was on par with *PK*- B @ 5% - 4 sprays (286 and 274 kg ha^{-1}, respectively). The lowest was noticed with *PK* - B @ 9% to soil (220 and 215 kg ha^{-1}, respectively). 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 (Mohd 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.

Urease activity

The data regards to urease activity in soil at flowering and harvest during *rabi* 2007-2008 and *kharif* 2008 are presented in table 2. Different treatments of *panchakavya* showed significant effect on urease activity in soil at both the stages during both the years except at harvest of Ashwagandha. The urease activity in soil has decreased from flowering to harvest ranged from 37.24 to 45.73 in *rabi* 2007-08 and 41.40 to 45.57 µg of NH_4^+ released g^{-1} soil h^{-1} in *kharif* 2008.

Flowering

Application of *PK*- C @ 15% to soil (85.24 and 81.07 µg of NH_4^+ released g^{-1} soil h^{-1}) recorded the highest soil urease activity followed by *PK* - B @ 15% to soil (83.52 and 78.80 µg of NH_4^+ released g^{-1} soil h^{-1}) and *PK* - C @ 5% - 4 sprays (81.54 µg of NH_4^+ released g^{-1} soil h^{-1} during both the years, respectively). All the treatments showed build up of urease activity when compared with initial urease activity (62.18 and 40.08 µg of NH_4^+ released g^{-1} soil h^{-1} during *rabi* 2007-08 and *kharif* 2008). The highest build up was recorded with *PK*- C @ 15% to soil followed by *PK* - B @ 15% to soil and the lowest build up was noticed in *PK* - C @ 5% - 4 sprays.

Harvest

In *rabi* 2007-08, among all the treatments application of *PK*- C @ 15% to soil recorded the highest soil urease activity (44.56 µg of NH_4^+ released g^{-1} soil h^{-1}) followed by *PK* - B @ 15% to soil (40.62 µg of NH_4^+ released g^{-1} soil h^{-1}). All the treatments showed depletion of urease activity when compared with initial urease activity (62.18 µg of NH_4^+ released g^{-1} soil h^{-1}). The highest depletion was recorded with *PK* - B @ 3% - 3 sprays (-52.64%) and the lowest depletion was noticed in *PK* - C @ 15% to soil (-28.34%). While in *kharif* 2008, there was no significant difference in urease activity in soil observed with all the treatments. It had ranged from 27.29 µg of NH_4^+ released g^{-1} soil h^{-1} with *PK*- B @ 3% - 4 sprays to 35.50 µg of NH_4^+ released g^{-1} soil h^{-1} with *PK*- C @ 15% to soil.

Dehydrogenase activity

The dehydrogenase activity in soil also has decreased from flowering to harvest during rabi 2007-08 and kharif 2008 ranged from 19.44 to 42.00 and 27.12 to 41.36 µg of TPF g^{-1} soil day^{-1}, respectively. Different treatments of *panchakavya* showed significant effect on dehydrogenase activity in soil at flowering and harvest in *rabi* 2007-08 and flowering in *kharif* 2008 (Table 2).

Flowering

During both the years, application of *PK*- C @ 15% to soil recorded the highest soil dehydrogenase activity which was on par with *PK* – B @ 15% to soil. In *rabi* 2007-08, all the treatments showed build up of dehydrogenase activity except *PK* - B @ 3% - 3 sprays (-2.08%) and *PK* - C @ 3% - 3 sprays (-7.47%) when compared with initial dehydrogenase activity (67.84 µg of TPF g^{-1} soil day^{-1}).

The highest build up was recorded with *PK* - C @ 15% to soil (34.21%). However in *kharif* 2008, all the treatments showed build up of dehydrogenase activity when compared with initial dehydrogenase activity (47.74 µg of TPF g^{-1} soil day^{-1}). The highest build up was noticed in *PK* - C @ 15% to soil (69.67%).

Harvest

Application of *PK*- C @ 15% to soil recorded the highest soil dehydrogenase activity (49.05 µg of TPF g^{-1} soil day^{-1}) followed by *PK*- B @ 15% to soil (47.00 µg of TPF g^{-1} soil day^{-1}. During both the years, all the treatments showed depletion of dehydrogenase activity when compared with initial dehydrogenase activity (67.84 and 47.74 µg of TPF g^{-1} soil day^{-1}, respectively). The highest depletion was recorded with *PK* - B @ 3% - 3 sprays (-45.96%) in *rabi* 2007-08 and with *PK* - B@ 15% to soil (-46.46%) in *kharif* 2008.

Table 1: Chemacal composition of *Panchakavya* made from cow and buffalo products

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)	38×10^4	32×10^4
Actinomycetes (CFU/ml)	4×10^2	47×10^2
Lactic acid bacteria (CFU/ml)	26×10^6	24×10^6

Table 2: Effect of *panchakavya* (made from cow and buffalo products) on dry root yield (kg ha^{-1}) of Ashwagandha at flowering and harvest during *rabi* 2007 - 2008 (I year) and kharif 2008 (II year)

Treatments	Rabi 2007-08 (Itear)		Kharif 2008 (IIyear)	
	Flowering	Harvest	Flowering	Harvest
T_1 - *PK* - C @ 3% - 3 sprays	80	241	85	230
T_2 - *PK* - C @ 5% - 3 sprays	104	271	104	258
T_3 - *PK* - C @ 3% - 4 sprays	84	259	89	234
T_4 - *PK* - C @ 5% - 4 sprays	108	290	112	280
T_5 - *PK* - B @ 3% - 3 sprays	74	223	80	220
T_6 - *PK* - B @ 5% - 3 sprays	91	263	101	255
T_7 - *PK* - B @ 3% - 4 sprays	87	235	89	226
T_8 - *PK* - B @ 5% - 4 sprays	102	286	107	274
T_9 - *PK* - C @ 9% to soil	82	230	73	226
T_{10} - *PK* - C @ 15% to soil	94	282	106	265
T_{11} - *PK* - B @ 9% to soil	80	220	70	215
T_{12} - *PK* - B @ 15% to soil	94	253	91	248
C.D (P = 0.05)	3.5	8.3	3.7	10.1
SE m	1.4	3.1	1.6	3.8

PK - C Panchakavya made from cow products
PK - B Panchakavya made from buffaloe products
3 sprays at 30, 60 and 90 DAS
3 sprays at 30, 60 and 90 DAS
panchakavya applied to soil as basal

At both the stages in both the years, among different sources of *panchakavya*, *panchakavya* made from cow and buffalo products showed statistically on par with each other with regards to enzymatic activity. The soil application of *panchakavya* showed statistically higher urease and dehydrogenase activity when compared with foliar application of *panchakavya.*

Among different concentrations of *panchakavya*, foliar application of 5% showed statistically higher urease and dehydrogenase activity when compared with 3% of foliar spray. Among different intervals of spray, 4 sprays of *panchakavya* showed statistically higher dehydrogenase activity when compared with 3 sprays of *panchakavya*. Irrespective of sources, application of *panchakavya* @ 15% to soil recorded higher urease and dehydrogenase activity and the lower dehydrogenase activity was noticed with 9% to soil.

The dehydrogenase enzyme activity is commenly used as an indicator of biological activity (Burns, 1978). Both the enzymes activity was increased at flowering and decreased more than half to harvest. The increase in enzymatic activity with soil application of *panchakavya* @ 15% may be due to stimulation of micro organism population because of addition of substrate and growth promoting substances that are present in *panchakavya*. The higher concentration of *panchakavya* which might have helped in releasing of these enzymes (Somasundaram *et al*., 2003). The activity of urease and dehydrogenase in soils showed significant positive correlation with organic carbon because the organic carbonis a seat of microbial population and their activity (Ananthanarayana and Mithyantha., 1970).

Table 3: Effect of *panchakavya (*made from cow and buffalo products) on soil urease activity of Ashwagandha at flowering and harvest during *rabi* 2007 - 2008 (I year) and kharif 2008 (II year)

Treatments	Rabi 2007-08 (Itear)		Kharif 2008 (IIyear)	
	Flowering	Harvest	Flowering	Harvest
T_1 - *PK* - C @ 3% - 3 sprays	73.52	30.85	72.84	29.84
T_2 - *PK* - C @ 5% - 3 sprays	77.14	32.14	74.00	30.85
T_3 - *PK* - C @ 3% - 4 sprays	71.54	34.30	73.26	31.86
T_4 - *PK* - C @ 5% - 4 sprays	81.54	38.10	77.69	33.87
T_5 - *PK* - B @ 3% - 3 sprays	70.22	29.45	73.47	31.05
T_6 - *PK* - B @ 5% - 3 sprays	75.24	32.97	70.65	28.08
T_7 - *PK* - B @ 3% - 4 sprays	79.53	33.80	75.25	27.29
T_8 - *PK* - B @ 5% - 4 sprays	78.52	38.50	72.13	30.05
T_9 - *PK* - C @ 9% to soil	79.25	38.92	75.80	33.85
T_{10} - *PK* - C @ 15% to soil	85.24	44.56	81.07	35.50
T_{11} - *PK* - B @ 9% to soil	80.87	36.15	76.08	32.86
T_{12} - *PK* - B @ 15% to soil	83.52	40.62	78.80	34.54
C.D (P = 0.05)	3.83	2.74	3.26	NS
SE m	1.42	1.08	1.16	0.98
Initial urease activity (µg of NH_4^+ released g^{-1} soil h^{-1})	62.18		40.08	

Table 4: Effect of *panchakavya (*made from cow and buffalo products) on soil dehydrogenase activity of Ashwagandha at flowering and harvest during *rabi* 2007 - 2008 (I year) and kharif 2008 (II year)

Treatments	Rabi 2007-08 (Itear)		Kharif 2008 (IIyear)	
	Flowering	Harvest	Flowering	Harvest
T_1 - *PK* - C @ 3% - 3 sprays	62.77	43.33	53.78	26.66
T_2 - *PK* - C @ 5% - 3 sprays	76.81	40.08	65.96	30.12
T_3 - *PK* - C @ 3% - 4 sprays	73.46	39.00	68.33	28.34
T_4 - *PK* - C @ 5% - 4 sprays	79.21	42.52	72.33	31.66
T_5 - *PK* - B @ 3% - 3 sprays	66.47	38.00	61.33	30.33
T_6 - *PK* - B @ 5% - 3 sprays	75.45	37.12	63.00	26.66
T_7 - *PK* - B @ 3% - 4 sprays	78.02	36.66	64.26	28.66
T_8 - *PK* - B @ 5% - 4 sprays	81.05	41.85	70.66	29.64
T_9 - *PK* - C @ 9% to soil	72.35	40.26	67.33	35.00
T_{10} - *PK* - C @ 15% to soil	91.05	49.05	81.00	39.64
T_{11} - *PK* - B @ 9% to soil	70.33	44.18	65.21	25.56
T_{12} - *PK* - B @ 15% to soil	84.68	47.00	75.00	38.33
C.D (P = 0.05)	6.82	4.160	5.14	NS
SE m	2.66	1.58	1.90	1.34
Initial dehydrogenase activity (µg of TPF g^{-1} soil day$^-$	67.84		47.74	

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