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Effect of Panchagavya on Growth and Yield of *Abelmoschus esculentus* cv. Arka Anamika

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A B S T R A C T

A field experiment was conducted in Thanthai Roever Institute of Agriculture and Rural Development (TRIARD), Perambalur field to find the variation in biochemical, growth, and yield parameters of *Abelmoschus esculentus* under different concentrations (Control, 1%, 3%, 5% and 7%) of panchagavya, and physic-chemical and biochemical properties were increased in 3% concentration. Since there was increase in growth and yield parameters at low concentration of panchagavya, it is recommended that the panchagavya can be used for spray after diluted properly to 3%.

Introduction

Heavy use of chemicals in agriculture has weakened the ecological base in addition to degradation of soil, water resources and quality of the food. At this juncture, a keen awareness has sprung on the adoption of "organic farming" as a remedy to cure the ills of modern chemical agriculture (Kannaiyan, 2000). With increased awareness on organic farming among the farming community, they are using many organic formulations in crop production for increasing the yield. The indiscriminate use of chemical pesticides in modern agriculture resulted in the development of several problems such as pesticide resistant insects, resurgences of target and non-target pests, destruction of beneficial organism like honey bee, pollinators, parasitors, and predators and pesticide residues in food and fodder. The awareness about the health and environmental problems due to the continuous use of pesticides resulted in the development of integrated pest management (IPM) and organic farming (Thomas and Prabhu, 2001; Prabhu, 2004).

Traditional organic formulation may contain numerous plant growth-promoting bacteria (PGPR), which may enhance plant growth by nitrogen fixation, growth hormone production and control phytopathogens (Amalraj *et al.*, 2013; Naik and Sreenivasa, 2009). In many

Asian countries, farmers formulate their own organic formulations by fermentation or composting. For example, in India, Panchagavya (PG) is one of the widely used traditional organic formulations, which is mostly prepared by farmers themselves.

Panchagavya is a term used in Ayurveda fermented product made from five ingredients obtained from cow, such as milk, urine, dung, curd and clarified butter (Amalraj *et al.,* 2013). Role of foliar applied panchagavya in production of many plantation crops has been well documented in India (Selvaraj, 2003). Panchagavya is a popular foliar nutrition prepared by organic growers of Tamil Nadu as an indigenous material and used widely for agricultural and horticultural crops (Swaminathan *et al.,* 2007). The present investigation was hypothesized to examine the effect of foliar application of panchagavya on different physiological parameters, yield and yield attributes of *Abelmoschus esculentus.*

Materials and Methods

The seeds of *Abelmoschus esculentus* (Hybrid – Arka anamika) were collected from the ROEVER KVK, Perambalur, Tamil Nadu. Panchagavya was prepared using the ingredients as mentioned in table 1. All these substrates were added to a wide mouthed mud pot and kept open under shade. The contents were stirred twice a day for about 20 minutes both in the morning and evening to facilitate aerobic microbial activity. After fifteen days of incubation, the fermented product "Panchagavya" was used for further studies. Care should be taken not to mix any buffalo product. The products of local breeds of cow have more potency than exotic breeds. It should be kept in the shade and covered with a wired mesh or plastic mosquito net to prevent houseflies from laying eggs and the formation of maggots in the solution. Panchagavya can be stored for 60 days.

Design of the experiment

Experiment Period: Jan 2017 to March 2017

Experimental Design: Randomised Block Design

Crop studied: *Abelmoschus esculentus*

Treatments

T1 – control
T2 – 1% panchagavya spray
T3 – 3% panchagavya spray
T4 – 5% panchagavya spray
T5 – 7% panchagavya spray

Field experiment was carried out to assess panchagavya foliar spray and seed treatment and also to arrive at the suitable dilution factor to change the growth and yield of *Abelmoschus esculentus*. The field experiment was conducted during January2017 to March2017 at TRIARD field, Perambalur, Tamil Nadu.

Physico-chemical and biological properties

Samples were drawn on weekly basis up to 6 weeks after preparation for the nutrients and microbial estimations. The pH of the sample was measured using a pH meter (Systronics: Model 335). Electrical conductivity (EC) was determined with the help of an EC meter (Elico: Model CM 180). The major nutrients such as nitrogen, phosphorus and potassium present in panchagavya were estimated by following microkjeldhal method (Jackson. 1973), Vanadomolybdate phosphoric yellow colour method (Jackson, 1967) and Flame photometry (Jackson, 1973) respectively. The micronutrients present in organic liquid manures were estimated using Atomic Absorption Spectrophotometer (AAS).

The serial dilution and standard plate count method was used for isolation of total

bacteria, fungi, actinomycetes and other biochemical groups *viz.*, bacteria, fungi and actinomycetes using nutrient agar, Martin's rose Bengal agar and Kenknights' agar respectively. The plates were incubated at 28±2°C for one week and the colony counts were recorded.

Foliar spray

For spray treatment, respective percentage of panchagavya solution was made. After dilution, the panchagavya solution has to be filtered before using it to spraying.

Panchagavya solution was sprayed at weekly interval up to 45th Day After Sowing.

Morphological studies

Morphological studies were observed in *Abelmoschus esculentus* and plant height (centimeter scale), number of leaves; fresh weight and dry weight (electrical single pan balance) were measured in various concentrations with various intervals (vegetative, flowering and maturity stage).

Estimation of Chlorophyll and carotenoid content by UV-VIS Spectrophotometer

Chlorphyll a, b and total chlorophyll content in the fresh leaves was determined for each treatment at various stages (seedling, flowering and yielding) of *Abelmoschus esculentus* using the method advocated by Arnon (1949). The amount of carotenoid present in the extract was calculated by using the formula (Kirk and Allen, 1965).

Yield parameters

The yield parameters studies observed in *Abelmoschus esculentus* on number of fruits and fruit weight (electrical single pan balance) were measured in various concentrations in maturity stage.

Results and Discussion

Physico-chemical and biological properties

Change in nutrient status and microbial load present in panchagavya are given in table 2. The indicated the presence of both major and micro nutrients in panchagavya in addition to different microflora especially bacteria. Presence of naturally occurring beneficial microorganisms predominantly bacteria, yeast, actinomycetes, photosynthetic bacteria and certain fungi were detected in organic liquid manures (Swaminanthan, 2005). Papen *et al.*, (2002) reported that panchagavya contains *Azotobacter*, *Azospirillum* and *phosphobacteria*. Panchagavya contains microorganisms in addition to nutrients that help in improving plant growth, metabolic activities and resistance to pest and diseases. In the present study, Microbial load i.e., bacteria, fungi and actinomycetes was increased up to 21th day $110x10^6$, $25x10^4$ and $21x10^3$ respectively. Effective Micro Organisms (EMO) in panchagavya were the mixed culture of naturally occurring beneficial microbes, mostly lactic acid bacteria (*Lactobacillus*), yeast (*Saccharomyces*), actinomyces (*Streptomyces*), photosynthetic bacteria (*Rhodopseudomonas*) and certain fungi (*Aspergillus*) (Xu, 2001; Swaminanthan *et al.*, 2007).

The pH of panchagavya increased from 6.47 (0th day) to 6.92 (28th day). Maximum electrical conductivity was noticed on 28th day (1.78 dSm^{-1}). The NPK content of the panchagavya 0.97, 0.92 and 0.65% was recorded maximum on 21st day after preparation respectively.

Foliar spray on morphological parameters

Field experiment was conducted to know the changes in morphological, biochemical and yield parameters of *Abelmoschus esculentus*

due to panchagavya spray. The morphological parameters of *Abelmoschus esculentus* at various stages (seedling, flowering and yielding) are shown in table 3.

The morphological parameters such as plant height, number of leaves, fresh weight and dry weight of *Abelmoschus esculentus* were increased with the age of the plant. The highest morphological parameters (Plant height 18.23, 68.35 and 74.68 cm/plant; the fresh weight 25.67, 99.02 and 99.69 mg/plant; and dry weight 9.60, 26.12, 24.15 mg/plant on seedling, flowering and yielding stage respectively) of *Abelmoschus esculentus* were recorded in the plants sprayed with 3% concentration of panchagavya when compared with control as well as other concentrations.

The photosynthetic pigments (chl. A, chl. B, and carotenoid) contents estimated at various growth stages of *Abelmoschus esculentus* grown under different concentration of panchagavya spray are given in table 4. The pigment content gradually increased in seedling and flowering, and decreased in yielding stage. The highest pigment contents (chl. A., 0.418, 0.434, and 0.281 mg/plant; chl. B, 0.398, 0.491 and 0.272 mg/plant; carotenoid, 0.361, 0.440 and 0.268 mg/plant on seedling, flowering and yielding stage respectively) of *Abelmoschus esculentus* were recorded in the 3% concentration of panchagavya spray when compared with control and other concentrations.

Plants sprayed with panchagavya invariably produce bigger leaves and develop denser canopy (Somasundaram *et al.,* 2007; Tharmaraj *et al.*, 2011). According to Muthuvel (2002) four sprays of panchagavya at 3% resulted in higher plant height and number of branches per plant. Present studies revealed that foliar spray of panchagavya at 3% resulted in significant increase in yield attributes. This is in agreement with the finding of Birendra and Christopher (2007) and Rajesh and Kaliyamoorthy (2013). Similar finding were observed in black gram (Swaminathan *et al.,* 2007) and *Coleus forskohili* (Kanimozhi, 2004).

Table.1 Ingredients involved in Panchagavya preparation

Sl. No.	Ingredients	Quantity
1	Fresh cow dung	5 kg
2	Cow's urine	3 litre
3	Cow's milk	2 litre
4	Cow's curd	2 litrs
5	Cow's ghee	½ kg
6	Jaggery	½ kg in 3 litre of water
7	Tender Coconut water	3 litre
8	Banana (ripe)	12 nos
9	Toddy or grape juice	2 litre

Table.2 Changes in Physico-chemical and biological properties of Panchagavya with time

Sl. No.	Available nutrient status					Physical properties		Microbial load (Population = X cfu ml^{-1})		
	N	p	K	Ca	Mg	EC (dSm^{-1})	pH	Bacteria (10^6)	Fungi (10^4)	Actinomycetes (10^3)
0^{th} day	0.18	0.02	0.24	0.54	0.81	0.62	6.47	10	4	8
7^{th} day	0.32	0.13	0.41	1.01	1.16	0.73	6.53	21	9	16
14^{th} day	0.62	0.12	0.53	1.15	1.13	0.98	6.72	38	14	18
21^{st} day	0.97	0.28	0.65	1.31	1.63	1.20	6.83	110	25	21
28^{th} day	0.77	0.18	0.45	1.24	1.28	1.78	6.92	68	22	20

*Values represent mean of three replications

Table.3 The morphological parameters of *Abelmoschus esculentus* grown under different concentrations of Panchagavya spray

Concentrations of Panchagavya	Seedling Stage				Flowering Stage				Yielding Stage			
	Plant Height (cm/plant)	Fresh Weight (mg/plant)	Dry weight (mg/plant)	No. of leaves	Plant Height (cm/plant)	Fresh Weight (mg/plant)	Dry weight (mg/plant)	No. of leaves	Plant Height (cm/plant)	Fresh Weight (mg/plant)	Dry weight (mg/plant)	No. of leaves
Control	16.86	24.70	7.22	3	64.24	88.29	19.52	21	64.44	97.00	19.88	25
1%	14.22	18.89	8.62	4	66.70	82.24	22.37	18	69.20	89.30	19.32	24
	(-15.65)	(-23.52)	(19.39)	(33.33)	(3.82)	(-6.85)	(14.60)	(-14.28)	(7.38)	(-7.93)	(2.81)	(-4.16)
3%	18.23	25.67	9.60	5	68.35	99.02	26.12	24	74.68	99.69	24.15	28
	(8.12)	(3.92)	(32.96)	(66.66)	(6.39)	(12.15)	(33.81)	(14.28)	(15.89)	(3.05)	(21.47)	(12.00)
5%	14.96	19.46	8.32	4	65.45	83.54	24.11	22	71.23	98.30	22.39	22
	(-11.26)	(-21.21)	(15.23)	(33.33)	(1.88)	(-5.37)	(23.51)	(4.76)	(10.53)	(1.34)	(12.62)	(-12.00)
7%	15.28	22.55	7.47	4	67.23	85.77	23.08	22	70.00	90.40	23.01	24
	(-9.37)	(-8.70)	(3.46)	(33.33)	(4.65)	(-2.85)	(18.23)	(4.76)	(8.62)	(-6.80)	(15.74)	(-4.00)

Note: (±) percentage over control is expressed in parenthesis

Table.4 Photosynthetic pigment contents of *Abelmoschus esculentus* grown under different concentrations of Panchagavya spray

Concentrations of Panchagavya	Seedling Stage			Flowering Stage			Yielding Stage		
	Chlorophyll a (mg/plant)	Chlorophyll b (mg/plant)	Carotenoid (mg/plant)	Chlorophyll a (mg/plant)	Chlorophyll b (mg/plant)	Carotenoid (mg/plant)	Chlorophyll a (mg/plant)	Chlorophyll b (mg/plant)	Carotenoid (mg/plant)
Control	0.272	0.161	0.264	0.293	0.277	0.198	0.156	0.177	0.162
1%	0.336 (23.52)	0.221 (37.26)	0.272 (3.03)	0.321 (9.55)	0.342 (23.46)	0.188 (-5.05)	0.211 (35.25)	0.188 (6.21)	0.157 (-3.08)
3%	0.418 (53.67)	0.298 (85.09)	0.361 (36.74)	0.434 (48.12)	0.491 (77.25)	0.340 (71.71)	0.281 (80.12)	0.272 (53.67)	0.268 (65.43)
5%	0.322 (18.38)	0.210 (30.43)	0.275 (4.16)	0.345 (17.74)	0.322 (16.24)	0.289 (45.95)	0.167 (7.05)	0.271 (53.10)	0.261 (61.11)
7%	0.302 (11.02)	0.193 (19.87)	0.278 (5.30)	0.317 (8.19)	0.312 (12.63)	0.184 (-7.07)	0.201 (28.84)	0.182 (2.82)	0.172 (6.17)

Note: (±) percentage over control is expressed in parenthesis

Table.5 Yield parameters of *Abelmoschus esculentus* grown under different concentrations of Panchagavya spray

Concentration	No. of fruits/plant	Fruit Weight (mg/fruit)
Control	11	26.82
1%	14 (27.27)	21.66 (19.23)
3%	19 (72.72)	30.67 (14.35)
5%	17 (54.54)	23.44 (12.60)
7%	18 (63.63)	21.28 (20.65)

Note: (±) percentage over control is expressed in parenthesis

The photosynthetic pigments content such as chl. A, chl. B and carotenoid of *Abelmoschus esculentus* were increased in 3% panchagavya spray and decreased in control and other concentration. Similar findings were observed in *Arachis hypogaea* (Subramaniyan, 2005) and *Vigna radiate*, *Vigna mungo* and *Oryza sativa* (Tharmaraj, 2011).

Foliar spray on yield

The yield parameters such as number of fruit and fruit weight of *Abelmoschus esculentus* sprayed with different concentration of Panchagavya is presented in table 5. The highest yield parameters such as number of fruit (19), and fruit weight (30.67 mg/fruit) of *Abelmoschhus esculentus* were recorded in the plants sprayed with 3% concentration of panchagavya when compared with control as well as other concentrations.

Using panchagavya helps to increase the and more yield and quality of the products (Subramaniyan, 2005) as compared to chemical fertilizers, this is less expensive and more ecofriendly with no side effects. The yield parameters (number of fruit, and fruit weight of *Abelmoschus esculentus* were increased in 3% panchagavya spray when compared with control and other concentration.

Similar findings were observed in *Vigna mungo* and *Oryza sativa* (Rajasekaran and Balakrishanan, 2002), black gram and green gram (Brito and Girija, 2006) and groundnut (Ravikumar *et al.,* 2012). Panchagavya enhances the growth and vigour of crops, inducing resistance to pests and diseases and improving the keeping quality of vegetables and fruits (Natarajan, 2002). Panchagavya spray was also reported as effective on all the crops than the recommended nutrients and growth (RFS) in terms of higher growth and productivity.

The present research work was carried out to study the effect of panchagavya spray on gowth, yield and biochemical changes in *Abelmoschus esculentus*. All parameters were increased in 3% concentration. Since, there was increase in growth and yield at low concentration of panchagavya, it is recommended that the panchagavya can be used for spray after diluted properly. Cow's urine provides nitrogen which is essential for crop growth.

Milk provides protein, fat, carbohydrates, amino acid and calcium. Curd provides lactobacillus which act as catalyst in the digestion of organic waste. Ghee provides vitamins A and B, calcium and fat. These contents stimulate the growth and yield of all vegetable crops.

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