



# Effect of Growing Media and Cow Urine on Seedling Growth, Leaf Nutrient Status and Economics of Papaya (*Carica papaya* L.)

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

In recent decades, research attention is focusing on utilize animal wastes for the quality planting material production with the various growing media. In this study, a pot experiment was conducted on papaya cv. Arka Surya at the nursery unit of the Department of Horticulture, Agricultural University of Kota, Rajasthan to assessment the impact of growing media and organic liquid (cow urine) on seedling growth, leaf nutrient status and economic attributes. This experiment was laid out in a factorial complete randomized design with two factors consisting eleven growing media and two levels of cow urine (with or without). Among different treatments combination used the medium Soil + Sand + Vermiculite + Cocopeat + Perlite (1:1:1:1:1) with cow urine found significantly superior over other treatments and control with respect to maximum leaf area (51.85 cm<sup>2</sup>), vigour index-I (1550.27 cm), vigour index-II (59.55 g), fresh weight of seedling (2.86 g) and dry weight of seedling

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(0.42 g) at 75 days after sowing. The highest number of secondary roots (17.00) were also found in the same treatment as compared to rest of the treatments. Further, it was also found superior with relation to maximum nitrogen (1.87%), phosphorus (1.14%) and potassium (2.26%) content. The highest number of stout and healthy seedlings (9000) per 250 g seeds. Therefore, maximum total gross return (₹ 90000) obtained by selling of these seedlings with higher net income (₹ 17363) due to treatment T10-Soil + Sand + Vermiculite + Cocopeat + Perlite (1:1:1:1) with cow urine over control. However, it is recommended that Soil + Sand + Vermiculite + Cocopeat + Perlite (1:1:1:1) with cow urine should be used for healthier growth and higher nutrient quality with more net profitability.

**Keywords:** Papaya; growing medium; cow urine; growth; leaf nutrients; economics.

## 1. INTRODUCTION

"Papaya (*Carica papaya* L.) is a tropical fruit crop and belongs to family Caricaceae having commercial importance because of its high nutritive and medicinal value. It is native of tropical America and was introduced to India in 16<sup>th</sup> century. It is being grown in almost all tropical and subtropical countries in the world like Sri Lanka, Tanzania, India, Hawaii, Florida, Philippines, South Africa and Australia. In India it extensively grown in various states like Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, West Bengal, Chhattisgarh, Tamil Nadu, Assam and Kerala" [1]. "In Rajasthan papaya is grown in Bhilwara, Bharatpur, Chittorgarh, Dausa, Jaipur, Karauli and Udaipur districts. The most beneficial conditions for papaya growth are well-draining and well-aerated soils containing rich organic matter" [2]. "Typically, plants die within 3-4 days in water-logged soils" [3]. "The composition of the medium influences the quality of the seedlings" [4].

"Growing media of different origin take on the role of soil and provide anchorage for the root system, supply water and nutrients for the plant and guarantee adequate aeration in the root area" [5]. "Cow urine is a unique product of dairy which have huge property such as manure, antimicrobial agent and disinfectant. It contains 95 per cent water, 2.5 per cent urea and 2.5 per cent enzymes" [6]. "In organic farming cow urine is used for preparation of number of growth promoter and bio-pesticides which are effective in improving soil fertility and management of large number of pests and diseases in varied groups. The biochemical contents of the plants increased with cow urine application. Therefore, the use of cow urine provides better alternative to synthetic chemicals which are expensive and pose potential danger to the farmers, marketers, consumers and environment. Cow urine contains about 1.21 per cent N<sub>2</sub>, 0.01 per cent, P<sub>2</sub>O<sub>5</sub> and 1.35 per cent K<sub>2</sub>O with micronutrients like, Fe,

Mn, Zn and Cu" [7]. Accordingly, this study was carried out in order to determine the effect of growing media and cow urine on the seedling growth, leaf nutrient status and economics of papaya seedlings.

## 2. MATERIALS AND METHODS

A pot experiment on papaya cv. Arka Surya was conducted at the nursery unit of the Department of Horticulture, Agricultural University of Kota, Rajasthan which was located in a semi-arid climatic regies the soil fertility. Cow urine has amazing germicidal power to kill wide varieties of germs (on during the month of July in the year 2019. In this investigation consisting of 2 factors *i.e.* growing media or rooting media and cow urine. During the investigation used 11 media combinations with or without cow urine, comprising of total 22 treatments, *i.e.* soil (control) (T<sub>0</sub>), soil + sand (1:1) (T<sub>1</sub>), soil + vermiculite (1:1) (T<sub>2</sub>), soil + cocopeat (1:1) (T<sub>3</sub>), soil + perlite (1:1) (T<sub>4</sub>), soil + vermiculite + perlite (1:1:1) (T<sub>5</sub>), soil + vermiculite + cocopeat (1:1:1) (T<sub>6</sub>), vermiculite + perlite + cocopeat (1:1:1) (T<sub>7</sub>), soil + sand + vermiculite + perlite (1:1:1:1) (T<sub>8</sub>), soil + sand + vermiculite + cocopeat ( 1:1:1:1) (T<sub>9</sub>), soil + sand + vermiculite + cocopeat perlite (1:1:1:1:1) (T<sub>10</sub>). To make the 15% cow urine solution, a small amount of 150 ml cow urine was dissolved in 1 liter water and treated papaya seed for 24 hours after that sown in trays.

The leaf area was calculated using a graph paper and expressed as a centimetre square (cm<sup>2</sup>). Vigour index- I and II were calculated according to formula given by Abdul-Baki and Anderson [8];

Seedling vigour index I = Germination percentage × Seedling length (cm)

Seedling vigour index II = Dry weight of seedlings (g) × Germination percentage

The number of secondary roots were counted after 75 days of sowing from each replication

after uprooted of seedling. Fresh weight of seedling was measured by electronic balance at 75 days after sowing and average weight was expressed in gram. The seedlings which were earlier selected for fresh weight dried in oven at 60°C for 48 hours till a uniform drying and it was measured by electronic balance and expressed in gram.

Nitrogen content in leaves was estimated by using micro Kjeldahl distillation method [9]. Phosphorus content in leaves was determined by Vando-molybdophosphate yellow colour method [10] and potassium content in leaves was determined by Flame photometric method [10]. The economic attributes of healthy seedlings obtained from various treatments was converted into gross return in rupees based on the current market prices for the sale. After subtracting the gross return of control from the gross return of other treatments, the additional income over control for each treatment was determined and after subtracting the additional treatment cost from additional income over control, the net profit due to treatment was determined.

The data pertaining to various parameters on growth, nutrient content of seedlings was subjected to statistical analysed with factorial completely randomized design [11]. Person correlation matrix among the various attributes was analysed using R software (R version 4.2.3, India).

### 3. RESULTS AND DISCUSSION

#### 3.1 Effect of Growing Media and Cow Urine on Growth Attributes

The leaf area of papaya seedlings has been influenced significantly by rooting media and cow urine (Fig. 1). In treatment T<sub>10</sub>-Soil + Sand + Vermiculite + Cocopeat + Perlite (1:1:1:1:1) observed highest leaf area (49.77 cm<sup>2</sup>) and which was followed by T<sub>9</sub> (49.49 cm<sup>2</sup>), while, smallest leaf area (36.19 cm<sup>2</sup>) was noted in T<sub>0</sub> (Control). Application of cow urine significantly influenced leaf area and registered highest (44.88 cm<sup>2</sup>) with cow urine application, while, lowest leaf area (41.45 cm<sup>2</sup>) was observed without application of cow urine. Whereas, the interaction effect between growing media and application of cow urine was noted statistically non-significant for leaf area. However, Vigour index-I and II of papaya seedling were affected significantly by various growing media and cow urine application at 75 DAS (Table 1). In growing media containing Soil + Sand + Vermiculite +

Cocopeat + Perlite (1:1:1:1:1)-T<sub>10</sub> recorded higher vigour index-I and II (1308.12 and 56.50, respectively) as compared to other treatments of growing media. While, in T<sub>0</sub> (Control) registered lower vigour index-I and II (643.43 and 30.17, respectively). Application of cow urine influenced significantly of VI-I and II and observed higher VI-I and II (1054.43 and 40.85, respectively) with the application of cow urine. However, lower VI-I and II (799.31 and 35.90, respectively) observed without application of cow urine. The combine effect of growing media and cow urine was registered statistically significant for VI-I and II. Maximum VI-I and II (1550.27 and 59.55, respectively) were noted in T<sub>10</sub> with cow urine, whereas, treatment T<sub>0</sub> without cow urine showed lower VI-I and II (611.11 and 28.75, respectively). Application of cow urine with treatment T<sub>10</sub> was followed by T<sub>9</sub> for VI-I and II (1382.58 and 51.22, respectively) with cow urine.

Fresh and dry weight of papaya seedling were influenced significantly by various growing media and cow urine application (Table 2). In growing media consists Soil + Sand + Vermiculite + Cocopeat + Perlite (1:1:1:1:1)-T<sub>10</sub> registered maximum fresh and dry weight of seedling (2.54 and 0.37 g, respectively) as compared to rest of treatments of growing media. Whereas, in T<sub>0</sub> (Control) observed minimum fresh and dry weight of seedling (1.84 and 0.23 g, respectively). Application of cow urine affect significantly of fresh and dry weight of seedling and recorded maximum (2.33 and 0.33 g, respectively) with the application of cow urine. While, minimum fresh and dry weight of seedling (1.91 and 0.26 g, respectively) registered without application of cow urine. The interaction effect of growing media and cow urine was registered statistically significant for fresh and dry weight of seedling. Highest fresh and dry weight (2.86 and 0.42 g, respectively) were observed in T<sub>10</sub> with cow urine, whereas, treatment T<sub>0</sub> without cow urine showed lowest fresh and dry weight (1.61 and 0.20 g, respectively). The number of secondary roots of papaya seedling affected significantly by using of different growing media and application of cow urine (Fig. 2). Growing media consisting Soil + Sand + Vermiculite + Cocopeat + Perlite (1:1:1:1:1)-T<sub>10</sub> exhibited higher number of secondary roots (15.50) as compared to rest of the growing media and treatment T<sub>0</sub> (Control) exhibited lower number of secondary roots (11.84) of seedling. The effect of cow urine observed significant and maximum number of secondary roots of seedling (14.44) were recorded with cow urine application and

minimum (12.80) was noted without application of cow urine. This attribute influenced significantly by combined treatment of growing media and cow urine. The highest number of secondary roots (17.00) were recorded in treatment T<sub>10</sub> with cow urine and treatment T<sub>0</sub> without cow urine enumerated lowest (11.17).

The significant influence might be due to the presence of growth promoting substances (auxins) and nutrients in cow urine and various

growing medias used during the experimentation, which leads to better growth of papaya seedlings. The combination of different growing medias i.e. soil, sand, vermiculite, perlite and cocopeat media, attributed proper aeration and high water holding capacity which helped to better growth and development of seedlings. These results were in close conformity with finding of Mandal et al. [12], Singh et al. [13], Sharma et al. [14] and Sharma et al. [15] in papaya.

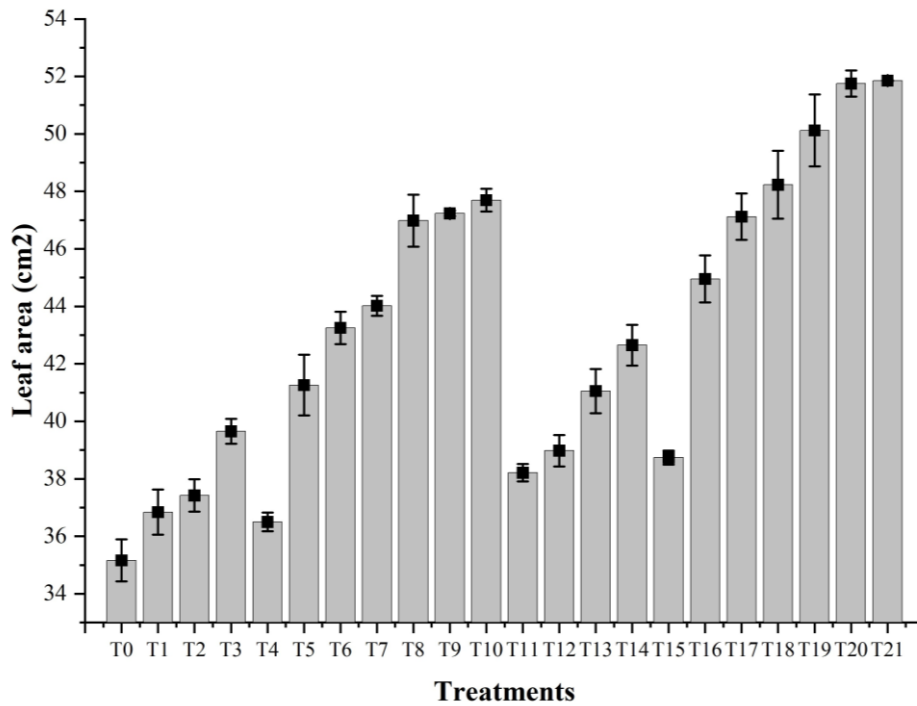


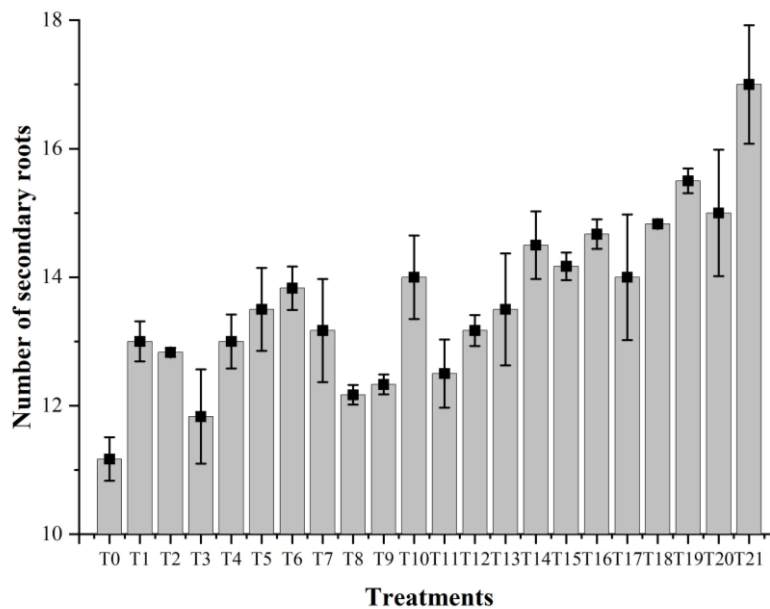
Fig. 1. Effect of growing media and cow urine on leaf area of papaya

Table 1. Effect of growing media and cow urine on vigour index-I and II of papaya

Treatments	Vigour index-I			Vigour index-II		
	Without Cow Urine	With Cow Urine	Mean	Without Cow Urine	With Cow Urine	Mean
T <sub>0</sub>	611.11	675.75	643.43	28.75	31.58	30.17
T <sub>1</sub>	659.89	754.97	707.43	30.49	34.40	32.45
T <sub>2</sub>	673.93	823.50	748.72	30.66	35.61	33.14
T <sub>3</sub>	711.38	912.56	811.97	32.35	35.03	33.69
T <sub>4</sub>	745.37	945.51	845.44	33.42	36.90	35.16
T <sub>5</sub>	798.51	1031.09	914.80	32.76	38.77	35.77
T <sub>6</sub>	898.51	1130.32	1014.42	34.92	40.22	37.57
T <sub>7</sub>	792.03	1133.54	962.79	36.39	38.77	37.58
T <sub>8</sub>	863.90	1258.64	1061.27	38.22	47.25	42.74
T <sub>9</sub>	972.10	1382.58	1177.34	44.03	51.22	47.63
T <sub>10</sub>	1065.96	1550.27	1308.12	53.44	59.55	56.50
<b>Mean</b>	<b>799.31</b>	<b>1054.43</b>		<b>35.90</b>	<b>40.85</b>	
	<b>Media (M)</b>	<b>Cow urine (C)</b>	<b>M × C</b>	<b>Media (M)</b>	<b>Cow urine (C)</b>	<b>M × C</b>
<b>SEm±</b>	10.42	4.44	14.74	0.36	0.16	0.52
<b>C.D. at 5%</b>	29.71	12.67	42.02	1.03	0.47	1.50

**Table 2. Effect of growing media and cow urine on fresh and dry weight of seedling of papaya**

Treatments	Fresh weight of seedling (g)			Dry weight of seedling (g)		
	Without Cow Urine	With Cow Urine	Mean	Without Cow Urine	With Cow Urine	Mean
T <sub>0</sub>	1.61	2.06	1.84	0.20	0.26	0.23
T <sub>1</sub>	1.91	2.43	2.17	0.25	0.29	0.27
T <sub>2</sub>	1.94	2.15	2.05	0.26	0.30	0.28
T <sub>3</sub>	1.92	2.19	2.06	0.22	0.27	0.25
T <sub>4</sub>	1.74	2.29	2.02	0.25	0.28	0.27
T <sub>5</sub>	2.01	2.21	2.11	0.27	0.36	0.32
T <sub>6</sub>	1.77	2.22	2.00	0.28	0.33	0.31
T <sub>7</sub>	2.09	2.54	2.32	0.24	0.30	0.27
T <sub>8</sub>	1.82	2.32	2.07	0.28	0.39	0.34
T <sub>9</sub>	1.98	2.31	2.15	0.29	0.40	0.35
T <sub>10</sub>	2.22	2.86	2.54	0.32	0.42	0.37
<b>Mean</b>	1.91	2.33		0.26	0.33	
	<b>Media (M)</b>	<b>Cow urine (C)</b>	<b>M × C</b>	<b>Media (M)</b>	<b>Cow urine (C)</b>	<b>M × C</b>
<b>SEm±</b>	0.02	0.01	0.03	0.003	0.001	0.004
<b>C.D. at 5%</b>	0.06	0.02	0.08	0.008	0.003	0.011



**Fig. 2. Effect of growing media and cow urine on number of secondary roots of papaya seedling**

Cow urine contains many nutrients and plays a role in forming the plant's dry material and it can increase plant growth [16], due to availability of nitrogen content. Nitrogen plays a role in forming chlorophyll, amino acids, fats, enzymes and compounds needed in plant physiological processes to produce photosynthates. Further, the cow urine was maintaining of high water content in cell, increased cell division and cell elongation, which increased the overall growth of the seedlings, which may, helped to increase seedling vigour and fresh and dry weight of root

and shoot of papaya seedlings. These results were in close agreement with Shinde and Malshe [17] in *Khirni* when they used cow urine as a seed soaking, Sutteesh et al. [18] in sandalwood, Singh et al. [13,15] in papaya.

### 3.2 Effect of Growing Media and Cow Urine on Leaf Nutrient Status

Leaf nitrogen, phosphorus and potassium content of papaya seedling was affected significantly by various growing media and cow

urine application at 75 DAS (Table 3). In growing media containing Soil + Sand + Vermiculite + Cocopeat + Perlite (1:1:1:1:1)-T<sub>10</sub> recorded higher nitrogen, phosphorus and potassium (1.78, 1.10 and 2.26 %, respectively) as compared to other treatments of growing media and it was followed by soil + sand + vermiculite + cocopeat (1:1:1:1)-T<sub>9</sub> i.e. 1.76, 1.07 and 2.06 %, respectively. While, in T<sub>0</sub>-(Control) registered lowest nitrogen, phosphorus and potassium (1.05, 0.47 and 1.39 %, respectively). Application of cow urine influenced the content of nitrogen, phosphorus and potassium and observed maximum (1.47, 0.82 and 1.85 %, respectively) with the application of cow urine. However, minimum nitrogen, phosphorus and potassium (1.36, 0.74 and 1.75 %, respectively) observed without application of cow urine. The combine effect of growing media and cow urine was registered statistically significant for leaf nutrient content. Maximum nitrogen, phosphorus and potassium (1.87, 1.14 and 2.26, respectively) were noted in T<sub>10</sub> with cow urine and it was followed by T<sub>9</sub> (1.84, 1.12 and 2.19 %, respectively) with cow urine, whereas, treatment T<sub>0</sub> without cow urine registered minimum nitrogen, phosphorus and potassium (1.02, 0.45 and 1.36 %, respectively).

Leaf nutrient content of papaya seedlings affected significantly due to the higher uptake of nutrients, particularly nitrogen when the seed soaking with cow urine and grown in different growing media. Propagation media used in raising horticultural plants in the nursery are mostly organic or inorganic in nature and plays important role in seed germination not only acts as growing place but also as a source of nutrients for plant growth. This fact is supported by the works of Pafli [19] that "the uptake of nitrogen, the chief constituent of chlorophyll, protein and amino acids is accelerated through its increased supply at appropriate time to the plants". "This might be due to stimulated nutrient uptake specially nitrogen and synthesis of chlorophyll which have role in the assimilation of numerous amino acids that, are subsequently incorporated in proteins and nucleic acid, which provides framework for chloroplast results into better chlorophyll content in leaves of plant under this treatment" [20]. "Cow urine can increase the concentration of uptake of N, P and K" [16]. The cow urine and growing media contain significant

amounts of major nutrients like nitrogen, phosphorus and potassium required for soil mineral balance and fertility. Singh et al. [21] has reported that "high dose of cow urine application resulted in increased dissolved nutrients of amended soils". "Significantly higher soil organic carbon and available N, P and K were obtained with the applications of cow urine with other formulations" [22].

### 3.3 Effect of Growing Media and Cow Urine on Economics

The data regarding the estimated relative economics of various treatment combinations presented in Table 4 and revealed that the treatment T<sub>10</sub> i.e. consists Soil + Sand + Vermiculite + Cocopeat + Perlite (1:1:1:1:1) with cow urine had used under study produced the maximum number of stout and healthy seedlings (9000) per 250 g papaya seeds.

Therefore, total gross return obtained by selling of these seedlings (@ ₹ 15 per seedling) appeared to ₹ 90000. This treatment also exhibited maximum net profit of ₹ 17363 and it was followed by treatment T<sub>9</sub> with cow urine (₹ 15563). Cow urine is used because of its yearlong availability, cost-effectiveness, special sanctity attached to the cow in India and high success rate of seedling production with higher net return.

### 3.4 Correlations among Various Parameters under the Investigation

Significant correlations were observed between different growth and leaf nutrient content attributes (Fig. 3). The maximum positive correlation was observed between nitrogen and phosphorus (0.995) and phosphorus and potassium (0.995) which was followed with good significant positive correlations between nitrogen and potassium (0.993); leaf area and nitrogen (0.983); leaf area and potassium (0.979); leaf area and phosphorus (0.978); vigour index-I and vigour index-II (0.909); and leaf area and vigour index-I (0.902). The lowest significant positive correlation was observed between fresh weight of seedling and phosphorus (0.519) which was followed by potassium (0.538) and nitrogen (0.549).

**Table 3. Effect of growing media and cow urine on leaf nitrogen, phosphorus and potassium content of papaya**

Treatments	Nitrogen content in leaf (%)			Phosphorus content in leaf (%)			Potassium content in leaf (%)		
	Without Cow Urine	With Cow Urine	Mean	Without Cow Urine	With Cow Urine	Mean	Without Cow Urine	With Cow Urine	Mean
T <sub>0</sub>	1.02	1.07	1.05	0.45	0.49	0.47	1.36	1.41	1.39
T <sub>1</sub>	1.10	1.15	1.13	0.49	0.53	0.51	1.45	1.54	1.50
T <sub>2</sub>	1.21	1.30	1.26	0.61	0.68	0.65	1.56	1.67	1.62
T <sub>3</sub>	1.31	1.42	1.37	0.69	0.75	0.72	1.65	1.77	1.71
T <sub>4</sub>	1.11	1.21	1.16	0.50	0.55	0.53	1.48	1.56	1.52
T <sub>5</sub>	1.36	1.47	1.42	0.76	0.82	0.79	1.76	1.89	1.83
T <sub>6</sub>	1.43	1.52	1.48	0.81	0.90	0.86	1.85	1.96	1.91
T <sub>7</sub>	1.51	1.62	1.57	0.86	0.95	0.91	1.91	2.03	1.97
T <sub>8</sub>	1.62	1.76	1.69	0.92	1.05	0.99	2.01	2.11	2.06
T <sub>9</sub>	1.68	1.84	1.76	1.01	1.12	1.07	2.10	2.19	2.15
T <sub>10</sub>	1.69	1.87	1.78	1.05	1.14	1.10	2.16	2.26	2.21
<b>Mean</b>	1.36	1.47		0.74	0.82		1.75	1.85	
	<b>Media (M)</b>	<b>Cow urine (C)</b>	<b>M × C</b>	<b>Media (M)</b>	<b>Cow urine (C)</b>	<b>M × C</b>	<b>Media (M)</b>	<b>Cow urine (C)</b>	<b>M × C</b>
<b>SEm±</b>	0.005	0.012	0.016	0.003	0.008	0.011	0.02	0.05	0.07
<b>C.D. at 5%</b>	0.014	0.033	0.047	0.010	0.022	NS	0.06	NS	0.21

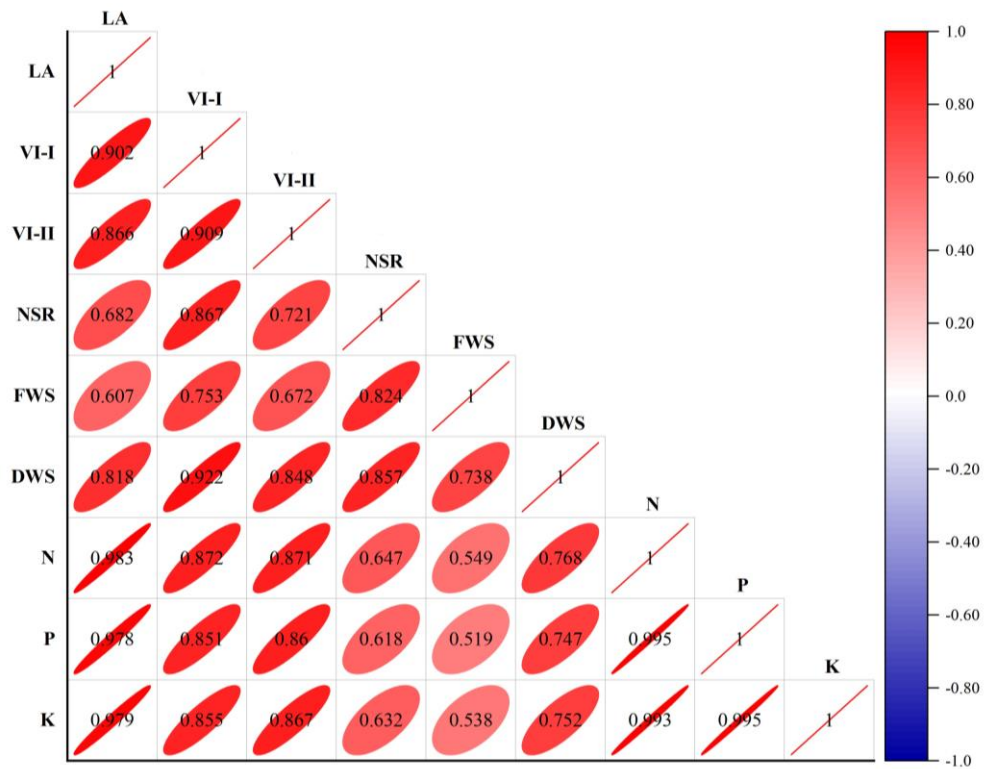
Table 4. Effect of growing media and cow urine on relative economics of different treatments of papaya

Treatments	Additional treatment cost (₹)	No. of seedlings obtained from 250 g seeds *	Gross return of seedling (₹) **	Additional income over control (₹)	Net profit due to treatment (₹)
T <sub>0</sub>	0	7200	72000	0	0
T <sub>1</sub>	200	7400	74000	2000	1800
T <sub>2</sub>	600	7300	73000	1000	400
T <sub>3</sub>	475	7300	73000	1000	525
T <sub>4</sub>	850	7400	74000	2000	1150
T <sub>5</sub>	1300	7600	76000	4000	2700
T <sub>6</sub>	1135	7900	79000	7000	5865
T <sub>7</sub>	1000	8000	80000	8000	7000
T <sub>8</sub>	715	8300	83000	11000	10285
T <sub>9</sub>	432	8400	84000	12000	11568
T <sub>10</sub>	632	8600	86000	14000	13368
T <sub>0</sub>	5	7400	74000	2000	1995
T <sub>1</sub>	205	7600	76000	4000	3795
T <sub>2</sub>	905	7700	77000	5000	4095
T <sub>3</sub>	480	7700	77000	5000	4520
T <sub>4</sub>	1705	7800	78000	6000	4295
T <sub>5</sub>	1305	8000	80000	8000	6695
T <sub>6</sub>	1140	8200	82000	10000	8860
T <sub>7</sub>	1005	8400	84000	12000	10995
T <sub>8</sub>	720	8500	85000	13000	12280
T <sub>9</sub>	437	8800	88000	16000	15563
T <sub>10</sub>	637	9000	90000	18000	17363

\* 250g papaya seed contain 10000 seeds

\*\* The cost of papaya seedling is ₹ 10 per seedling





**Fig. 3. Correlation matrix using Pearson coefficients among various attributes of papaya cv. Arka Surya influenced by different growing media and cow urine**

Note: LA: Leaf area; VI-I: Vigour index-I, VI-II: Vigour index-II, NSR: Number of secondary roots, FWS: Fresh weight of seedling, DWS: Dry weight of seedling, N: Nitrogen content, P: Phosphorus content and K: Potassium content

#### 4. CONCLUSION

In conclusion, growing media and cow urine influenced plant growth (leaf area, vigour index, number of secondary roots and weight of seedling) and leaf nutrient status (nitrogen, phosphorus and potassium content) of papaya during the experimentation. On the basis of result obtained from the pot experiment, best quality papaya seedlings were obtained with maximum estimated net income over control when seeds sown in medium consisting Soil + Sand + Vermiculite + Cocopeat + Perlite (1:1:1:1:1) seed treatment with cow urine. Therefore, it is recommended that this growing media combination along with cow urine should be used for better growth and high nutrient quality with more net profitability by orchardist.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exists.

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