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Effect of soaking time of cow urine and rooting media on seed germination of Kagzi lime (*Citrus aurantifolia* Swingle)

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Abstract

The experiment was conducted to study the effect of soaking time of cow urine and rooting media on seed germination of Kagzi lime. Twenty-one treatment combinations consisting of three main plot treatments of cow urine C_o (seed soaked in distilled water for 12 hrs.), C_1 (Seed soaked in 10% cow urine for 24 hrs.) and C_2 (Seed soaked in 10% cow urine for 12 hrs.). Seven sub plot treatments of rooting media M_o (only soil), M_1 [soil + FYM (3:1)], M_2 (Soil + vermicompost (3:1)], M_3 [soil + FYM (1:1)], M_4 [soil + vermicompost (1:1)], M_5 [soil + FYM (1:3)] and M_6 [soil + vermicompost (1:3)] were replicated thrice in split plot design. The observations were recorded replication wise by selecting five random plants for seven parameters, which includes seed germination and seedling growth. The results revealed that minimum days taken to start germination, taken to 50% germination and maximum percentage of germination was observed in (C_1) seed soaked in 10% cow urine for 24 hrs. Similarly, the treatment C_1 significantly increased the growth characters *viz*., number of roots/seedling, height of seedling, number of leaves/seedling and leaf area index. As regards the rooting media, M_6 significantly influences all the parameters. It was also superior to rest of the rooting media. Among the interactions of cow urine and rooting media, no any interaction was found significantly superior, but C_1M_6 treatment combination gave superior results over remaining treatment interactions.

Key words: *Cow urine, rooting media, kagzi lime, F.Y.M, vermicompost, germination*

Introduction

Kagzi lime (*Citrus aurantifolia* Swingle) is one of the most important tropical and subtropical fruit after than Mandarin and Sweet orange of rutaceae family. In India, Kagzi lime occupies, 2,58,000 hectare area with the annual production of 2.569 million tonnes (Anonymous, 2014). Due to, which there is tremendous scope of this crop to capture the market throughout the year. It is successfully grown in state of Andhra Pradesh, Maharastra, Tamil Nadu and Madhya Pradesh. In M.P., it is mostly grown as commercial crop in east and west Niwar and some part of Malwa and Mahakaushal region.

Lime is usually propagated by seeds and maximum germination can be obtained by sowing of freshly extracted seed up to 2 days only, which are polyembryonic in nature. The seedlings are almost true to the type and free from virus infection. Raising seedlings of Kagzi lime is often associated with many problems. Under field condition, it is common observation that the seed germination is poor and secondly the seedling growth is slow. The rate of mortality is also very high due to which it is difficult to raise a large population. Plant takes about 1½ to 2 years duration for planting in orchards due to slow growth rate of seedling (Singh *et.al*., 2004). There are some difficulties in the cultivation of the crop and the present investigation has been undertaken with an intense urged to overcome them.

In recent year, lots of research work has been done on different aspects of growth regulators. The important aspects among them are the most appropriate growth regulators for encouraging germination and further growth. To overcome this crisis some alternatative for growth regulator should be brought up which may be as efficient as growth regulators, easy to access and cheap. This has diverted the attention once again towards the chemical, cane sugar, cow urine, which were in use as a growth regulators. Cow urine proving feasible may

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bring a breakthrough in the present context as it is free of cost and easily available. Cow urine contains nitrogen, sulphur, ammonia, copper, iron, urea, uric acid, phosphate, sodium, potassium, manganese, carbolic calcium, salt, vitamins, lactose, enzyme, water, creatinin, aurum hydroxide etc. (Sankaranarayana *et.al*., 1994)**.** In view of above facts, the experiment was conducted to study the effect of soaking time of cow urine and rooting media on seed germination and seedling growth of Kagzi lime .

Materials and Methods

The experiment was conducted at Fruit Research Station, Imalia, Department of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.). In this experiment the response of cow urine and different rooting media was evaluated for germination and vegetative growth of Kagzi lime seeds. The experiment was laid out in split plot design with three replications. For rooting media, soil, FYM and Vermicompost are obtained. Polybags of 20 cm length and 30 cm diameter with 200 gauge thickness were used. Fully ripened and healthy fruits of uniform size were taken and seeds were extracted carefully. Extracted seeds were washed in running water and dried under shade condition. Cow urine was taken from desi breed at morning time.Ten treatments combination consisting of three main plot treatments of cow urine C_0 (seed soaked in distilled water for 12 hrs.), C_1 (Seed soaked in 10% cow urine for 24 hrs.), and C_2 (Seed soaked in 10% cow urine for 12 hrs.) and seven sub plot treatments of rooting media M_0 (only soil), M_1 [soil + FYM (3:1)], M_2 (Soil + vermicompost (3:1)], M_3 [soil + FYM (1:1)], M_4 [soil + vermicompost (1:1)], M_5 [soil + FYM (1:3)] and M_6 [soil + vermicompost (1:3)] were replicated thrice in split plot design.

Three treated seeds were sowed at 1-2 cm depth in polythene bags which were consisted in different rooting media. After germination only one seedling was retained, other was removed. Intermittent hand weeding was done as and when needed. Roger (0.2%) was sprayed thrice i.e. after emergence of seedling, one month after emergence and two months after emergence. 1% urea was sprayed twice on the seedling once 60 days after sowing. The standard horticultural practices were adopted for raising the seedlings. Parameters regarding seed germination and growth were recorded *viz.*, Days taken to start germination, Days taken to 50% germination, Percentage of germination, Height of seedling (cm.) Number of leaves/seedling, Leaf area index (cm^2) and number of roots per seedling. The data collected during the investigation were analyzed statistical by the method of "Analysis of variance". The significance of various treatments was judged as suggested by Gomez and Gomez (1984) applying "F" Test.

Results and Discussion

Days taken to start germination

The data taken pertaining to days to start germination was recorded and statisticaliy analyzed. A perusal of data presented in Table 1 indicates that treatment of cow urine and rooting media significantly decreased the days taken to start germination. Under this experiment, C_1 (seed soaked in 10% cow urine for 24 hrs.) recorded significantly minimum days taken to start germination after sowing (13.33) followed by C_2 (seed soaked in 10% cow urine for 12 hrs.), which recorded 13.76. C_0 (control) taken significantly maximum days to start germination, which at par with C_2. As regards the rooting media, M_6 [soil + vermicompost (1: 3)] was recorded the significantly minimum days taken to start germination (12.55) followed by M_5 [soil + FYM (1: 1)] and M_4 [soil vermicompost (1:1)] which recorded 13.11 and 13.44 respectively and the treatment did not defer significantly each other. M_0 (only soil) showed significantly maximum days taken to start germination, which is at par with M1. It is emphasized from the table that interaction of cow urine and rooting media are found non significant, however minimum days taken to start germination 11.66 was noted under the combination of C_1M_6 [seed soaked in 10% cow urine for 24 hrs and soil + vermicompost (1:3)]. The results are inconformity to the results as reported by Rajwar *et al.,* (2007) in case of wild Ber (*Zizyphus rotundifolia).*

Days taken to 50% germination

The tabulated result clearly shows that treatments of cow urine and rooting media significantly influence the days taken to 50% germination (Table 2). It indicates that the cow urine C_1 (seed soaked in 10% cow urine for 24 hrs.) recorded significantly minimum days taken to 50% germination (18.42) after sowing followed by Cow urine C_2 (seed soaked in 10% cow urine for 12 hrs.), which recorded 19.85 days taken to 50% germination, while C_0 (control) recorded significantly maximum (20.76) days taken to 50% germination. Among the rooting media, M_6 [soil + vermicompost (1:3)] taken significantly minimum days to 50% germination (16.55), followed by M_5 [soil + FYM (1:3)]. The probable reason may be that the medium M_6 creates sufficient porus space, better drainage of water and sufficient aeration for better rooting of seed or may be due to increased physiological activities of seed, essential for cell division, cell enlargement or both. These results are in conformity with the result of Deol and Uppul, (1990). M_0 (only soil) recorded the significantly maximum days taken to 50% germination (23.00), which is at par with M_1 [soil + FYM (3:1)]. As regard interaction, the interaction of cow urine and media are found non

significant, however, minimum days taken to 50% germination (15.00) was recorded under the combination of C_1M_6 [seed soaked in 10% cow urine for 24 hrs and soil + vermicompost (1:3)]. Similar findings have already been reported by Bertocci *et al.*, (1997) in germination response of Papaya.

Percentage of germination

Pertaining to percentage of germination was recorded at 30 days after sowing and data was statisticalil analyzed. The results elucidated in Table 3 indicates that the treatment of cow urine and rooting media significantly increased the percentage of germination. It is clear from the statistical data that maximum (67.29) percentage of germination was observed under C_1 (seed soaked in 10% cow urine for 24 hrs.) at 30 days after sowing followed by C_2 (seed soaked in 10% cow urine for 12 hrs.), which recorded 63.4 but not significant better than control. Increase percentage of germination due to cow urine may be due to fact that perhaps cow urine activated the embryos and estimated the release of enzyme in endosperm, which in turn liberate the food substances required by quick growing embryo and seedling. These findings are in agreement with results of Pandey and Singh (2000) in germination of guava seeds. In case of rooting media, M_6 [soil + vermicompost (1:3)] recorded significantly maximum (80.70) percentage of germination followed by M_5 [soil + FYM (1:3)] and M_4 [soil + vermicompost (1:1)], which recorded 74.07 and 72.22, respectively. M_0 (control) showed significantly minimum percentage of germination 45.92 followed by M_1 [soil + FYM (3:1)] 52.21. However, maximum germination percentage (84.44) was recorded under the combination of C_1M_6 [seed soaked in 10% cow urine for 24 hrs and soil + vermicompost (1:3)]. More or less similar results have been reported by Singh, *et al.* (2000).

Height of seedlings

An effect of application of cow urine and

Table 1. Effect of soaking time of cow urine and rooting media on days taken to start germination of Kagzi lime.

Treatments	Media							Mean
Cow urine	M_0	M_1	M_2	M_3	M_4	M_5	M_6	
C_0	16.33	15.66	15.00	14.66	14.00	13.66	13.33	14.66
C_1	15.00	13.66	13.66	13.33	13.00	12.66	11.66	13.33
C_2	15.33	14.66	13.66	13.66	13.00	13.00	12.66	13.76
Mean	15.55	14.77	14.11	13.88	13.44	13.11	12.55	

Treatments	S.Em±	C.D at 5% level
C (cow urine)	0.24	0.98
M (media)	0.36	1.03
CxM (interaction)	0.67	NS

Table 2. Effect of soaking time of cow urine and rooting media on days taken to 50% germination of Kagzi lime.

Treatments	Media							Mean
Cow urine	M_0	M_1	M_2	M_3	M_4	M_5	M_6	
C_0	24.00	22.66	21.66	20.66	19.33	19.00	18.00	20.76
C_1	22.00	20.66	19.33	18.00	17.33	16.66	15.00	18.42
C_2	23.00	21.00	20.66	20.33	18.66	18.66	16.66	19.85
Mean	23.00	21.44	20.55	19.66	18.44	18.11	16.55	

Treatments	S.Em±	C.D at 5% level
C (cow urine)	0.150	0.57
M (media)	0.60	1.70
CxM (interaction)	1.031	N.S

Table 3. Effect of soaking time of cow urine and rooting media on percentage of germination of Kagzi lime.

Treatments	Media							Mean
Cow urine	M_0	M_1	M_2	M_3	M_4	M_5	M_6	
C_0	42.21	47.77	54.44	59.99	70.00	71.10	77.66	60.45
C_1	49.99	56.66	62.21	66.66	74.44	76.66	84.44	67.29
C_2	45.55	52.21	56.66	63.33	72.22	74.44	79.99	63.40
Mean	45.92	52.21	57.77	63.33	72.22	74.07	80.70	

Treatments	S.Em±	C.D at 5% level
C (cow urine)	0.94	3.70
M (media)	1.88	5.40
CxM (interaction)	3.26	NS

rooting media significantly influenced the vegetative growth of plant. The data on the height of seedlings were recorded at 60, 75, 90, 105, 120 and 135 days after sowing (Table 4). Among the different concentrations of cow urine, C_1 (seed soaked in 10% cow urine for 24 hrs.) recorded the significantly higher plant height (6.45, 7.45, 8.60, 9.55, 10.51 and 11.76 cm at 60, 75, 90, 105, 120 and 135 days after sowing respectively), followed by C_2 (seed soaked in 10% cow urine for 12 hrs.) which recorded 5.94, 6.98, 8.00, 8.93, 9.80 and 10.82 cm at various stages respectively.

This may be due to Cow urine seems to affect physiochemical characteristics of seed and thus give positive response to germination, emergence, vigour and plant height of seedlings. Similar results were also recorded by Parameswari *et al.* (2001) in tamarind seed. The table 4 further indicates that M_6 [soil + vermicompost (1:3)] recorded significantly higher plant height (8.05, 9.17, 10.41, 11.53, 12.56 and 13.93 cm at various stages,respectively), followed by M_4 [soil + vermicompost (1:1)] might be due to vermicompost which had supplied available plant nutrients and brought about a favorable soil environment, which ultimately increased the nutrient and water holding capacity of soil. It is much closed related with Kumar and Satyawati (2007) in *Jatropha curcus*. Whereas, M_0 (control) reported significantly minimum height of seedling (4.08, 4.69, 5.39, 5.88, 6.30, and 7.05) at various stages, respectively followed by M_1 [soil + FYM 3:1)].

Number of leaves/seedling

The data pertaining to number of leaves/ seedling was recorded after 60 to 135 days after sowing

Table 4. Effect of soaking time of cow urine and rooting media on height of seedling at various stages of Kagzi lime.

Treatments	Days after sowing					
Cow urine	60	75	90	105	120	135
C_0	5.43	6.38	7.33	8.26	9.11	9.85
C_1	6.45	7.45	8.60	9.55	10.51	11.76
C_2	5.95	6.98	8.00	8.93	9.80	10.82
SEM ±	0.04	0.04	0.05	0.05	0.07	0.13
C.D at 5% level	0.17	0.18	0.21	0.22	0.25	0.52
Media						
M_0	4.08	4.69	5.39	5.88	6.30	7.05
M_1	5.06	5.95	6.96	7.85	8.71	9.61
M_2	5.43	6.48	7.50	8.45	9.29	10.24
M_3	5.64	6.88	7.89	8.91	9.85	10.62
M_4	6.84	7.85	9.01	10.03	11.11	12.24
M_5	6.50	7.54	8.70	9.76	10.83	12.00
M_6	8.05	9.17	10.41	11.53	12.56	13.93
SEM ±	0.14	0.13	0.14	0.14	0.15	0.23
C.D at 5% level	0.39	0.39	0.41	0.40	0.43	0.65

at a regular interval of 15 days under different treatments of cow urine and rooting media. Among the cow urine, C_1 (seed soaked in cow urine for 24 hrs.) and among rooting media, M_6 [soil + vermicompost (1:3)] produced the maximum number of leaves/seedling at all the successive stages of seedling growth. It is apparent from Table 5 that cow urine C_1 produced significantly more number of leaves seeding 8.30, 11.39, 13.94, 15.84, 18.51 and 21.51 at 60, 75, 90, 105, 120 and 135 days after sowing respectively, followed by C_2. While C_0 (control) produced significantly minimum number of leaves *i.e.,* 6.83, 9.31, 11.30, 13.34, 15.25 and 17.60 at various stage, respectively sowing. Shaban (2010) who reported that the probable reason of enhances more number of leaves per plant in cow urine treated seed that it might have resulted in more production of photosynthets and their translocation through phloem to the whole plant might be responsible for improving the vegetable growth which finally helps in increase number of leaves per seedling. It further reveals the rooting media, M_6 [soil + vermicompost (1:3)] produced the significantly maximum number of leaves/ Seedling 9.27, 13.50, 17.27, 20.83, 24.43 and 28.38 at various stages, respectively, followed by rest of the rooting media. These results are in consonance with the findings as reported by Verma and Prasad (2005). Among the interactions, the interaction between cow urine and rooting media not produced significantly higher number of leaves/seeding.

Leaf area index

As far as the leaf area index (LAI) is concerned, maximum (2.55 cm^2) LAI was found under C_1 (seed soaked in 10% cow urine for 24 hrs.) at 135 days after sowing. The value of LAI increased due to maximum length and width of leaves produced by synergistic effect of cow urine and their movement increased the synthesis of biomass and accumulation of photosynthates that is responsible for higher leaf area index. The improvement of leaf area index in cow urine treated seeds has been reported by Shirol *et al.* (2005) in Khirnee seeds. Among the rooting media, M_6 [soil + vermicompost (1:3)] encouraged significantly larger leaf area index 1.018, 1.513, 1.990, 2.452, 2.828 and 3.227 cm^2 at 60, 75, 90, 105, 120 and 135 days after sowing, respectively (Table 6). It was superior to rest of the rooting media. Whereas, M_0 (only soil) showed significantly minimun leaf area index at various stages. It is possible due to rapid multiplication of new cells in higher ratio of vermicompost rooting media which helped increasing in term of length and width of leaves as reported by Norman *et al.*,(2003). Vermicopost contains macro and micro nutrients, enzymes, pro vitamins and growth hormones which are very effective in producing the superior length and width of leaves. Similar results were reported by Vijayananthan and Kumar (2006).

Number of roots/ seedling

The number of roots/seedling was measured at 60 and 135 days after seed sowing. The statistical

Table 5. Effect of soaking time of cow urine and rooting media on number of leaves/seedling at various stages of Kagzi lime.

Treatment	Days after sowing					
Cow urine	60	75	90	105	120	135
C_0	6.83	9.31	11.30	13.24	15.25	17.60
C_1	8.30	11.39	13.94	15.84	18.51	21.51
C_2	7.54	10.39	12.61	14.80	16.90	19.67
SEM ±	0.093	0.115	0.20	0.20	0.22	0.19
C.D at 5% level	0.365	0.452	0.79	0.77	0.88	0.75
Media						
M_0	5.63	6.90	7.63	8.44	9.03	10.27
M_1	6.07	7.53	9.03	9.58	10.50	12.41
M_2	7.26	9.21	10.51	12.33	13.80	16.53
M_3	7.80	11.05	13.38	15.82	18.34	21.16
M_4	8.90	12.74	15.86	17.79	21.57	24.82
M_5	7.96	11.60	14.64	17.62	20.54	23.62
M_6	9.27	13.50	17.27	20.83	24.43	28.38
SEM ±	0.273	0.271	0.50	0.64	0.76	0.81
C.D at 5% level	0.783	1.066	1.42	1.83	1.93	2.32

Table 6. Effect of soaking time of cow urine and rooting media on leaf area index (cm^2) at various stages of Kagzi lime.

Treatments	Days after sowing					
Cow urine	60	75	90	105	120	135
C_0	0.773	1.081	1.362	1.623	1.866	2.161
C_1	0.922	1.288	1.600	1.914	2.208	2.551
C_2	0.844	1.185	1.500	1.773	1.989	2.355
SEM ±	0.023	0.013	0.023	0019	0.043	0.021
C.D at 5% level	0.093	0.051	0.092	0.076	0.172	0.083
Media						
M_0	0.516	0.685	0.831	0.930	1.063	1.190
M_1	0.716	0.960	1.222	1.357	1.531	1.725
M_2	0.837	1.126	1.355	1.567	1.769	2.008
M_3	0.887	1.243	1.495	1.887	2.182	2.512
M_4	0.992	1.419	1.873	2.220	2.527	3.010
M_5	0.958	1.348	1.678	1.990	2.249	2.810
M_6	1.018	1.513	1.990	2.452	2.828	3.227
SEM ±	0.045	0.042	0.057	0.066	0.087	0.089
C.D at 5% level	0.129	0.121	0.165	0.192	0.250	0.255

analysis of data (Table 7) revealed that the C_1 (seed soaked in 10% cow urine for 24 hrs.) induced the significantly maximum 9.77 and 29.02 number of roots/plant at 60 and 135 days after sowing, respectively. The minimum number of roots were noted under untreated treatment (C_0) at both stages, which is at par with C_2. This may be due to disinfectant action of cow urine, which might have avoided the basal portion of seed from decreasing and must have provided congenial environmental conditions for early initial of rooting. These findings are similar to the findings of Kumar *et al.*,(2012). In case of rooting media combination, the media M_6 [soil + vermicompost (1:3)] showed significantly the maximum 12.48 and 37.99 number of roots at both stages. Whereas, interaction of cow urine and rooting media are not significantly increase number of roots /plant at both stages of growth. The results of the present study are in consonance with the findings of Bisen *et al.*, (2010) who reported that the media M_6 creates sufficient porus space letting the excess water drain away, permitting adequate aeration for the better root length and number of roots/seedling. More or less similar results were also reported by Jain and Parmar (1993) and Arancon *et al.*, (2004) in strawberry.

Table 7. Effect of soaking time of cow urine and rooting media on number of roots/ seedling of Kagzi lime.

Treatments	Days after sowing	
Cow urine	60	135
C_0	7.96	23.95
C_1	9.7	29.02
C_2	8.78	26.42
SEM ±	0.23	0.25
C.D at 5% level	0.89	0.98
Media		
M_0	4.15	14.68
M_1	6.16	19.27
M_2	7.41	23.42
M_3	9.75	26.87
M_4	11.28	32.46
M_5	10.52	30.54
M_6	12.48	37.99
SEM ±	0.40	0.95
C.D at 5% level	1.15	2.73

References

Anonymous, 2014. 2nd Advance Estimate of Area and Production of Horticulture Crops, NHB, Gurgaon.

Arancon, N.Q., Edwards, C.A., Bierman, P., Welch C. and Metzger, J.D 2004. Influence of vermicompost on field strawberries: Effects on growth and Yields. *Bioresource Technology*, 93 (2):145-153.

Bisen, A., Pandey, S.K. and Mishra, S.P. 2010. Efficacy of bioregulators and rooting media on rooting and survival of air layers of guava. *Annals of Plant and Soil Research*, 12 (2):115-118.

Bertocci, F., Vecchio, V. and Casini, P. (1997). Effect of seed treatment on germination response of Papaya (*Carica papaya* L.). *Adv. Hort. Sci.*, 11:99-102.

Deol, L.S. and Uppul, D. K. 1990. Effect of different rooting media on rooting and growth hard wood and semi hard wood cutting of pomegrabate (*Punica granatum* L.). *Punjab Horti. J.*, 30(1-4): 140-144.

Gomez, K. A. and Gomez, A. A., 1984. Statistical procedures for agricultural research 2nd Ed., John Wiely and Sons, New York, NY.

Jain, P.K. Parmar, K.L. 1993. Response in hardwood cuttings of pomegranate (*Punica granatum* L.) treated with rooting media, IBA and Boran. *JNKVV, Res. J.*, 27 (10): 56-58.

Kumar, Ashwini and Sharma, Satyawati. 2007. Comparative study of effect of FYM and vermicompost on *Jatropha curcus* raised through cutting. In abstract, International Conference on Sustainable Agriculture for Food, Bio energy, Livelihood Security held at J.N.K.V.V, Jabalpur from 14-16, Feb. 40-41.

Kumar, Rajesh, Misra, K. K., Misra, D. S. and Brijwal, M. 2012. Seed germination of fruit crops: A Review. *Hort. Flora Research Spectrum*, 1(3): 199-207

Norman Q.A., Stephen, L., Clive, A. E. and Atiyeh, R. 2003. Effects of humic acids derived from cattle, food and paper waste vermicomposts on growth of green house plants. *Pedobiologia*, 47(5-6): 731-744.

Pandey, D. and Singh H.P.2000. Effect of seed pretreatment on promotion of germination in guava. *Ann. Agric. Res.*, 21:279-281.

Parameswari, K., Srimathi, P. and Malarkodi, K. 2001. Standardization of dormancy breaking treatment in tamarind (*Tamarindus indica* L.) *seed. Legume Research*, 24 (1) 60-62.

Rajwar,D.K., Shanker, R., Singh, S.K. and Bhagat, B.K. 2007. Seed germination and seedling growth of wild Ber (*Zizyphus rotundifolia* L.). *J. Res. Birsa Agric. Univ.*, 19:107-109.

Singh, D.K., Singh, B. and Sen, S.K. 2004.Role of pre-sowing seed treatment with different chemicals and seed sizes on the germination behavior and seedling growth of Ber (*Zizyphus mauritiana* L.).. *Env. and Eco.*, 22: 439-442.

Sankaranarayana, R.M., Kumar, Vijay and Rangasamy P. 1994. Cow urine ideal seed germination in Tamarinds, *Indian Hort. J.*, 38(4): 15.

Singh, R.R., Kaushik, J. C. and Singh, Jigar. 2000. Effect of soil media on germination shoot and root length and number of nodules of three nitrogen fixing tree species seedlings. *Indian Journal of Forestry*, 23(2): 157-159.

Shaban, A. E. A. 2010. Improving seed germination and seedling growth of some mango rootstocks. *American Eur Asian J. Agric. and Env. Sci.*, 7: 535-541.

Shirol, A.M., Hanamashetti, S.I., Kanamadi,V.C., Thammaiah, N. and Patil, S. 2005. Studies on pre-soaking, method and season of grafting of Sapota rootstock *Khirnee. Karnataka J. Agric. Sci.*, 18:96-100.

Verma, P. and Prasad, A. 2005. Vermicomposting: A potential technology for solid waste management. *Agrobios Newsletter*s, 4(5): 33-35.

Vijayananthan, K. and Kumar, M. G.2006. Vermiliquids: A better substitutes for synthetic hormones. *Agrobios Newsletters*, 4(10):8-9.