Short Communication

Growth media standardization and organic nutrient scheduling for container grown yardlong bean (*Vigna unguiculata* sub sp. *sesquipedalis* (L.) Verdcourt)

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Abstract

An investigation was undertaken at College of Agriculture, Vellayani, Thiruvananthapuram, Kerala during *Rabi* 2016-17 to standardize growth media and organic nutrient scheduling for container grown yardlong bean variety Githika. The treatments consisted of three growth media M_1: soil: sand: FYM (1:1:1) M_2: soil: sand: coirpith: FYM (1:0.75:0.25:1) M_3: soil: sand: coirpith: FYM (1:0.50:0.50:1) with three levels of nutrient viz., N_1: 100% recommended dose of NPK, N_2: 150% recommended dose of NPK and N_3: 200% recommended dose of NPK and two times of application T_1: Full NPK as basal, T_2: Half N, full P & K as basal+ half N as fermented groundnut cake at fortnightly intervals upto 50% flowering in two splits (30 and 45 DAS). Results of the study indicated that among the growth media, M_3 registered significantly higher values for growth parameters viz., primary branches, functional leaves per plant, crop duration and number of pods per plant and was on par with M_2. Pod yield per plant and number of pickings were superior for M_3. The different nutrient levels did not exert any significant influence on growth attributes. However, N_1 recorded the highest number of pods per plant and harvest index. Considering the time of application, T_2 was found superior with respect to most of the yield attributes *viz.*, number of pods per plant, pod yield per plant, total dry matter yield per plant, number of pickings and harvest index. Higher number of pods was recorded at all nutrient levels indicating the fact that whatever be the level of nutrient, split application of N helped in production of a greater number of pods. Among the third order interactions, $m_3n_1t_2$ registered the highest pod yield per plant (973.76 g).

Key words: Coir pith compost, Container/ growbag cultivation, Growth media, Organic nutrient scheduling, Urban farming, Yardlong bean.

In the light of declining farm land availability and labour shortage, conventional system of vegetable cultivation has its limits in Kerala. However, container gardening offers affordability and accessibility of fresh and organic vegetable for family consumption. Many fruits and vegetables can be produced with the right growing containers and growing media, irrespective of the spaces. Yardlong bean (*Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdcourt) is one of the most popular vegetable crops grown in Kerala, occupying an area of 6714 ha (FIB, 2016). Being a vigorous trailing annual producing very long slender pods, and an inexpensive source of highly nutritive vegetable protein, urban folks are greatly interested in taking up cultivation of yardlong bean in containers. However, majority of the urban dwellers, especially those living in very small holdings or apartments, lack the basic requirements for farming *viz.,* quality growth media for filling the containers or growbags. The potting media usually used for container cultivation is soil, sand and farmyard manure in the ratio 1: 1: 1. Sand being a costly and scarcely available input, it is essential to find a cheaper

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alternative for preparing the growth medium. Coir pith improves soil conditions like drainage and stimulates growth of most of the crops when used as rooting media. It can be used as an alternative to peat in growth medium,owing to its desirable physical and chemical properties (Savithri and Khan, 1994). High water holding capacity along with its air-filled porosity makes it an ideal growth medium. In this context, the possibility of utilising coir pith, which is available in plenty and helps in enhancing the moisture availability, as a substitute for sand needs to be studied. In the light of incidents reported earlier on poor quality of growth media supplied by various agencies,there is an urgent need for standardizing and developing a growth media for yardlong bean grown organically in containers.

Yardlong bean responds well to applied nutrients. At present, there is a lack of separate nutrient recommendation for yardlong bean grown organically in containers. Field studies revealed that application of excess organic manures may lead to excess vegetative growth. However, the effect of higher dose of organic nutrients on container grown yardlong bean has not been studied. Even though yardlong bean is a leguminous crop, for initial growth and establishment it needs a starter dose of nitrogen and split application of fermented manures may improve the response of applied nutrients. In this backdrop, the present investigation was undertaken to identify an ideal growth medium and to standardize an organic nutrient schedule for container (growbag) grown yardlong bean variety Githika.

The experiment was conducted at the Instructional Farm attached to College of Agriculture, Vellayani, Kerala, located at 8° 25' 46" N latitude 76° 59' 24" E longitude and at an altitude of 29 m above mean sea level from August 2016 to December 2016. The region enjoys a humid tropical climate experiencing a mean temperature of 20.7°C to 34.4°C and mean relative humidity of 85%. A total of 244.5 mm rainfall was received in 105 days during the cropping period. The treatments consisted of three growth media, M_1: soil: sand: FYM (1:1:1) M_2: soil: sand: coirpith: FYM (1:0.75:0.25:1) and M_3: soil: sand: coirpith: FYM (1:0.50:0.50:1), three levels of nutrients, N_1: 100% recommended dose of NPK, N_2: 150% recommended dose of NPK and N_3: 200% recommended dose of NPK and two time of application T_1: Full NPK as basal, T_2: Half N, full P & K as basal+ half N as fermented groundnut cake at fortnightly intervals up to 50% flowering in two splits (30 and 45 DAS). The *adhoc* NPK recommendation for yardlong bean (30: 30: 20 kg ha^{-1}) as per Packages of Practices Crops, Kerala Agricultural University was followed (KAU, 2011) and nutrient requirement calculated on the basis of plant population. Groundnut cake (5.786% N), fermented groundnut cake (4.665% N), bone meal (20% P_2O_5) and wood ash (2% K_2O) were used as nutrient sources for nitrogen, phosphorus and potassium respectively and applied as per the nutrient levels and time of application. Lime and neem cake each at 10 g per growbag were applied uniformly to all growbags before sowing.

The experiment was laid out as 3 x 3 x 2 factorial experiment with three replications in completely randomized design. The experimental site was cleared and black polythene mulch sheet was spread on the site. UV stabilized growbags of size 39 cm x 26 cm, capable of holding 12 kg potting mixture were filled with potting media prepared as per the treatments. Uniform quantity of potting media (9kg) was taken in each growbag. The growbags were placed at a spacing of 1.5 m between rows and 0.5 m between plants. Trellis system was erected for trailing the crop. Uniform mulching with dry leaves (100 g) was done in all growbags from 25 DAS. The weeds were removed from the growbags by hand, as and when they appeared and the plants were irrigated uniformly. Harvesting commenced from 47 DAS. Subsequent harvests of green pods were done on alternate days from all the treatments and fresh weight was recorded separately. Growth and yield attributes were recorded and data analysed statistically.

Growth media standardization for container grown yardlongbean

The study revealed that the various growth media tested had a significant influence on growth and yield characters of container grown yardlongbean. The effect of growth media, nutrient levels and time of application on vegetative and yield attributes and crop duration are given in Table 1. The growth media $M_3$and M_2recorded significantly higher values for all growth characters. These results indicated that coirpith could be effectively used for substituting sand to an extent of 50 per cent. However, a substitution upto 75 per cent reported by Baskar (1996), where potting mixture was composed of coirpith and soil in the ratio 75: 25, recorded an increased yield in yardlong bean. Both M_3 and M_2 also registered higher number of primary branches, functional leaves per plant (30 and 45 DAS) and longer crop duration. Moreover, substitution of 50 per cent coirpith could considerably reduce the weight of the growth medium which had more relevance for container cultivation in urban house terraces where it could be easily handled. Similar observation was also made by Joshua et al. (2012). Incorporation of coirpith as a component in growth medium extended the crop duration considerably. This might be due to maintenance of a favourable air to water balance in the root zone for a longer period of time as reported by Michel (2010). The number of pods per plant was highest for M_3(48.51) which was on par with M_2 (48.11). An increase in number of pods per plant could be attributed to the corresponding increase in the number of primary branches and functional leaves. Reddy (2005) observed a positive correlation between number of branches and pod yield in cowpea. The growth medium M_3 registered highest pod yield per plant(862.74 g) and was significantly superior to other growth media, which corresponded to the higher initial available nutrient status (0.085 per cent N, 0.042 per cent P_2O_5, 0.018 per cent K_2O and 3.8 per cent OC) and favourable chemical properties viz., neutral pH of 7.13 and EC of 1.3 dS m^{-1}. Reghuvaran and Ravindranath (2013) reported that coirpith could reduce the temperature of the medium and improve growth as well as yield characters. The number of pickings in M_3 was the highest (19.27) which might be due to the extended crop duration.

Table 1. Effect of growth media, nutrient levels and time of application on vegetative and yield characters of container grown yardlong bean

Treatments	Number of primary branches per plant		Number of functional leaves per plant		Crop duration (days)	Days for 50 per cent flowering	Number of pods per plant	Pod yield per plant(g)	Number of pickings	Harvest index
	30 DAS	45 DAS	30 DAS	45 DAS						
Growth media										
M_1	2.52	3.66	16.39	55.03	103.75	41.05	47.73	845.15	19.05	0.387
M_2	2.97	4.11	20.22	56.42	104.30	41.03	48.11	838.02	19.08	0.386
M_3	3.02	4.19	20.64	59.25	104.34	41.25	48.51	862.74	19.27	0.394
SEm(±)	0.11	0.11	0.82	1.03	0.13	0.06	0.21	4.50	0.05	0.001
CD (0.05)	0.325	0.312	2.342	2.957	0.37	0.162	0.591	12.906	0.146	0.003
Nutrient levels										
N_1	2.80	3.88	19.86	58.00	104.00	41.15	48.50	849.49	19.14	0.392
N_2	3.00	3.94	18.75	56.97	104.15	41.11	48.31	848.59	19.16	0.388
N_3	2.72	4.13	18.64	55.73	104.23	41.11	47.54	847.82	19.10	0.388
SEm(±)	0.11	0.11	0.82	1.03	0.13	0.06	0.21	4.50	0.05	0.001
CD (0.05)	NS	NS	NS	NS	NS	NS	0.591	NS	NS	0.003
Time of application										
T_1	2.96	4.05	18.54	56.54	104.02	40.52	45.48	797.70	18.55	0.377
T_2	2.72	3.92	19.63	57.26	104.24	41.72	50.75	899.57	19.72	0.401
SEm(±)	0.09	0.09	0.67	0.84	0.10	0.05	0.17	3.67	0.04	0.001
CD (0.05)	NS	NS	NS	NS	NS	0.132	0.483	22.355	0.119	0.003

Nutrient scheduling for container grown yardlongbean

Yardlong bean responds well to applied nutrients especially when grown in containers. The recommended dose as per *ad hoc* PoP (KAU, 2011) was 30: 20: 20 N: P_2O_5: K_2O kg ha^{-1}. For formulating a nutrient recommendation for yardlong bean grown in containers, different nutrient levels of 100, 150 and 200 per cent recommended dose (RD) of NPK were evaluated. The results of the study indicated that different nutrient levels had no influence on growth characters. This was in conformity with the findings of Babu (2015) who reported that different levels of nitrogen had no influence on growth parameters upto 60 DAS of yardlong bean. Duration of the crop was also unaffected by the different nutrient levels. On the contrary, Babu (2015) reported significant variation in crop duration with varying nutrient levels.

An increased number of pods per plant was noticed with the application of 100 per cent and 150 per cent RD of NPK (48.50 and 48.31 respectively). However, the increase in number of pods was not reflected in the pod yield. This clearly indicated that increasing the nutrient levels did not have any influence on pod yield of container grown yardlong bean and 100 per cent RD of NPK was sufficient

Table 2. Interaction effect of growth media, nutrient levels and time of application on vegetative and yield characters of container grown yardlong bean

Treatments	Number of primary branches per plant		Number of functional leaves per plant		Crop duration (days)	Days for 50 per cent flowering	Number of pods per plant	Pod yield per plant(g)	Number of pickings	Harvest index
	30 DAS	45 DAS	30 DAS	45 DAS						
M x N										
m_1n_1	2.25	3.50	19.17	55.75	103.92	41.17	49.25	840.72	19.17	0.393
m_1n_2	3.00	3.66	14.75	55.25	103.09	41.08	47.62	848.08	19.08	0.382
m_1n_3	2.33	3.83	15.25	54.10	104.23	40.89	46.33	846.65	18.89	0.385
m_2n_1	3.50	4.00	20.08	56.92	104.05	40.96	48.12	832.85	18.96	0.387
m_2n_2	2.83	4.41	20.25	56.67	104.73	40.62	50.25	804.60	18.79	0.377
m_2n_3	2.58	3.91	20.33	55.67	104.12	41.52	45.95	876.60	19.51	0.395
m_3n_1	2.66	4.16	20.33	61.33	104.03	41.31	48.12	874.92	19.30	0.396
m_3n_2	3.16	3.75	21.25	59.00	104.64	41.61	47.08	893.10	19.61	0.404
m_3n_3	3.25	4.66	20.33	57.42	104.34	40.91	50.33	820.22	18.90	0.382
SEm(±)	0.20	0.19	1.41	1.78	0.22	0.10	0.36	7.79	0.09	0.002
CD (0.05)	0.563	0.540	NS	NS	0.641	0.280	1.024	NS	0.253	0.006
N x T										
n_1t_1	2.77	4.11	19.61	59.17	103.98	40.51	46.08	802.18	18.51	0.380
n_1t_2	2.83	3.66	20.11	59.33	104.02	41.78	50.91	896.81	19.78	0.404
n_2t_1	3.00	3.83	18.06	56.94	103.90	40.42	46.22	790.06	18.52	0.372
n_2t_2	3.00	4.05	19.44	57.00	104.41	41.79	50.41	907.13	19.79	0.403
n_3t_1	3.11	4.22	17.94	55.57	104.17	40.63	44.13	800.88	18.62	0.380
n_3t_2	2.33	4.05	19.33	55.89	104.29	41.58	50.94	894.77	19.58	0.395
SEm(±)	0.16	0.15	1.15	1.48	0.18	0.08	0.29	6.36	0.07	0.002
CD (0.05)	0.460	NS	NS	NS	NS	0.229	0.836	NS	0.206	0.005
M x T										
m_1t_1	2.50	3.44	15.78	54.51	103.63	40.49	45.11	793.98	18.49	0.377
m_1t_2	2.55	3.88	17.00	55.56	103.86	41.61	50.36	896.32	19.60	0.396
m_2t_1	3.33	4.33	19.67	55.94	104.27	40.48	45.66	796.44	18.59	0.377
m_2t_2	2.61	3.88	20.78	56.89	104.39	41.58	50.55	879.59	19.58	0.395
m_3t_1	3.05	4.38	20.16	59.17	104.21	40.58	45.66	802.69	18.57	0.377
m_3t_2	3.00	4.00	21.11	59.33	104.47	41.97	51.36	922.80	19.97	0.411
SEm(±)	0.16	0.15	1.15	1.48	0.18	0.08	0.29	6.36	0.07	0.002
CD (0.05)	0.460	0.441	NS	NS	NS	NS	NS	18.253	0.206	0.005

for attaining higher pod yield. Suja (2006) observed that increasing N levels from 30 to 60 kg ha^{-1} had no influence on pod yield of yardlong bean. Split application of N also recorded a greater number of pickings (19.72) compared to application of full NPK as basal. Yardlong bean has an indeterminate growth habit in which continued vegetative growth and pod formation occurs upto the completion of its life cycle. Hence basal application of entire dose of nitrogen may not be sufficient to meet the requirement in later crop growth stages and split application would help to prolong the reproductive phase of the crop.

For formulating nutrient schedule, standardizing time of application of nutrients is as important as standardizing nutrient level. From the results of the study, it was observed that time of application had profound influence on number of pods and pod yield of yardlong bean. Among the times of application, T_2 was found superior with respect to most of the yield attributes *viz.*, number of pods per plant, pod yield per plant, total dry matter yield per plant, number of pickings and harvest index. However, it did not have any influence on growth characters and duration of the crop. In the present study, number of pods per plant (50.75) and pod yield per plant(899.57 g) were higher in split application of N with supply of half N, full P & K as basal and remaining N as fermented groundnut cake at fortnightly intervals up to 50% flowering (T_2). This was in conformity with the results reported by Babu (2015) in yardlong bean. Groundnut cake, which was used as the nitrogen source, had a C: N ratio less than 10:1 and was amenable for mineralization within one week after application. If the entire dose of nitrogen was applied basally, there were chances of leaching loss during periods of rainfall leading to nitrogen deficiency in plants. Moreover, as a legume, yardlong bean required a starter dose of nitrogen for quicker establishment. According to Misra and Ram (1971), application of smaller dose

Table 3. Interaction effect of growth media, nutrient levels and time of application on vegetative and yield characters of container grown yardlong bean

Treatments	Number of primary branches per plant		Number of functional leaves per plant		Crop duration (days)	Days for 50 per cent flowering	Number of pods per plant	Pod yield per plant(g)	Number of pickings	Harvest index
	30 DAS	45 DAS	30 DAS	45 DAS						
M x N x T										
$m_1n_1t_1$	2.00	3.66	18.83	54.00	103.91	40.71	48.00	816.10	18.71	0.389
$m_1n_1t_2$	2.50	3.33	19.50	57.50	103.93	41.64	50.50	865.33	19.63	0.397
$m_1n_2t_1$	3.33	3.33	13.50	55.50	102.70	40.29	45.50	769.67	18.29	0.365
$m_1n_2t_2$	2.66	4.00	16.00	55.00	103.47	41.88	49.75	926.50	19.88	0.398
$m_1n_3t_1$	2.16	3.33	15.00	54.03	104.28	40.48	41.83	796.17	18.48	0.378
$m_1n_3t_2$	2.50	4.33	15.50	54.17	104.18	41.31	50.83	897.13	19.30	0.393
$m_2n_1t_1$	3.50	4.16	19.83	55.50	104.11	40.65	46.75	814.37	18.64	0.382
$m_2n_1t_2$	3.50	3.83	20.33	58.33	103.99	41.27	49.50	851.33	19.27	0.392
$m_2n_2t_1$	2.83	4.50	19.67	57.17	104.51	39.74	49.00	751.17	18.07	0.360
$m_2n_2t_2$	2.83	4.33	20.83	56.17	104.95	41.51	51.50	858.03	19.50	0.395
$m_2n_3t_1$	3.66	4.33	19.50	57.17	104.03	41.06	41.25	823.80	19.06	0.390
$m_2n_3t_2$	1.50	3.50	21.17	56.17	104.22	41.97	50.66	929.40	19.97	0.400
$m_3n_1t_1$	2.83	4.50	20.17	61.83	103.93	40.17	43.50	776.07	18.17	0.369
$m_3n_1t_2$	2.50	3.83	20.50	60.83	104.13	42.44	51.33	973.77	20.44	0.423
$m_3n_2t_1$	2.83	3.66	21.00	58.17	104.49	41.22	44.16	849.33	19.22	0.391
$m_3n_2t_2$	3.50	3.83	21.50	59.83	104.79	42.00	52.75	936.87	20.00	0.416
$m_3n_3t_1$	3.50	5.00	19.33	57.50	104.21	40.34	49.33	782.67	18.33	0.372
$m_3n_3t_2$	3.00	4.33	21.33	57.33	104.47	41.47	50.00	857.77	19.47	0.393
SEm(±)	0.28	0.26	2.00	2.52	0.32	0.14	0.51	11.02	0.13	0.003
CD (0.05)	0.796	NS	NS	NS	NS	0.396	1.448	31.614	0.358	0.008

of starter nitrogen remarkably increased the yield of leguminous crops, and split application of nitrogen ensured availability of nitrogen throughout the growing period. The higher availability of nutrients might have enabled the plant to produce more number of flower buds which in turn increased the number of pods.

Among the second order interactions, M x N interaction had significant influence on primary branches per plant, crop duration and days to 50 per cent flowering. m_2n_1 recorded higher number of primary branches per plant at 30 DAS (3.50), which was on par with m_3n_3 (3.25), m_3n_2 (3.16) and m_1n_2 (3.00). At 45 DAS, the highest number of primary branches was recorded by m_3n_3 (4.66), which was on par with m_2n_2 (4.41) and m_3n_1 (4.16). The combination m_2n_2 registered longer crop duration which was on par with m_3n_2 (104.64), m_3n_3 (104.34), m_1n_3(104.23) and m_2n_3 (104.12). Lowest number of days for 50 per cent flowering was also recorded by m_2n_2 (40.62) which was on par with m_1n_3 (40.89). Higher number of pods was recorded in m_3n_3 (50.33), which was on par with m_2n_2 (50.25). However, the interaction effects had no influence on pod yield per plant. The same treatment combination (m_3n_2) could record more number of pickings (19.61) and higher harvest index (0.404).The treatment m_3n_3 (19.51) was on par with m_3n_2 for number of pickings.

Higher number of pods was recorded at all nutrient levels when half N, full P and K were applied basally, and half N was applied as fermented groundnut cake at fortnightly intervals upto 50 per cent flowering. This might be due to equal distribution of N during the entire growing period on split application especially during flowering and fruit setting stages. From these findings, it could be concluded that whatever be the level of nutrient, split application of N helped in production of more number of pods which is one of the important yield contributing characters. The same trend was observed in the case of number of pickings also.

The interaction effect of growth media and time of application have exerted significant impact on number of primary branches per plant, pod yield per plant, number of pickings and harvest index. Higher pod yield was registered by m_3t_2(922.80 g) which was a combination of medium composed of soil, sand, coirpith and FYM in the ratio 1: 0.5: 0.5: 1 by weight and split application of nitrogen. This might be attributed to the longer air to water balance provided by the coirpith and continued availability of nutrients throughout the cropping period by split application of nitrogen. Moreover, the cost involved in growth medium preparation was only ₹ 14.25 per bag since 50 per cent sand was substituted with coirpith as against ₹ 15.76 per bag in the conventional growth medium.

The higher order interaction between the main factors of M, N and T noticeably influenced pod yield per plant where $m_3n_1t_2$ recorded the highest pod yield per plant(973.77g) and was significantly superior over other treatment combinations. The higher yield in $m_3n_1t_2$could be the product of greater number of pods plant^{-1}(51.33) and number of pickings (20.44). Hence it could be concluded that the growth medium prepared by substituting 50 per cent sand by coirpith with basal application of 20 g groundnut cake, 10 g bone meal and 70 g wood ash followed by top dressing with fermented groundnut cake at 30 and 45 DAS was the best growth medium and organic nutrient schedule for container grown yardlong bean.

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