The Bioscan 10(2): 579-584, 2015
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

EFFECT OF PROPAGATION MEDIA AND BLACK POLYBAGS ON GROWTH AND SURVIVAL OF BUDDED KINNOW PLANTS

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KEYWORDS
Kinnow
Black poly bags
Propagation media

Received on :
19.01.2015

Accepted on :
17.04.2015

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ABSTRACT
The present study showed that the plants planted in black poly bag with holes of size 22x10x8 cm filled with propagation media soil: sand: vermicompost in the ratio of 1:1:1 recorded highest out planting performance (survival percentage) 93.33per cent with maximum leaf area (15.21 cm^2), number of primary roots (12.00) and secondary roots (99.67) as compared to other treatments. Similar treatment also showed maximum soil nitrogen (299 kg ha^{-1}), phosphorous (20.78 kg ha^{-1}), potassium (177.67 kg ha^{-1}), calcium (7.18 meq/100g) and magnesium (3.45 meq/100g) respectivelyafter six months of budded kinnow plants planted in black polybags.

INTRODUCTION

Kinnow mandarin (*Citrus reticulata* Blanco) is one of the most important citrus cultivar belonging to family Rutaceae. It is the first generation hybrid between King Mandarin (*C. nobilis* Lour.) × Willow leaf mandarin (*C. deliciosa* Tenora.) (Sharma *et al.*, 2012) developed by H.B. Frost at California and is one of the popular fruit among various citrus species. It has been originated from tropical and sub-tropical region of south East Asia, particularly India and China. In India most of the citrus nursery is grown as field nursery. In field nurseries, the eradication of soil borne pathogens like Phytophthora once introduced becomes very difficult. To avoid this problem, concept of containerised nursery system has to be standardized.

Raising of seedling in poly bags was introduced in 1969 in Ivory Coast superseding the techniques of conventional field nursery for production of vigorous seedlings (Kumar *et al.*, 2014). The natural development of root system remain more or less intact in polybags which ensures better growth of citrus plant (Khan *et al.*, 2006) after transplanting in the field and helps the trees resist strong winds and also gives them greater protection against drought in the initial years. The increased root length of container grown seedling tends to perform better on adverse site then do bare root seedlings and they also survive better under drought conditions (Amidon *et al.*, 1982).

In the recent years, the demands of quality planting material has been tremendously increasing and the availability of quality planting material in huge number is bottle neck because of high mortality of the kinnow plants in the nursery and after planting in the field. Therefore, it has become imperative to standardize the potting material with different propagation media for production of kinnow plants with the objectives to identify the type of potting material and propagation medium for the growth and survival of kinnow plants.

MATERIALS AND METHODS

The investigation was carried out at the Division of Fruit Science, Udheywalla, Faculty of Agriculture, SKUAST-Jammu. Udheywalla is situated in the sub-tropical zone at latitude of 32·40ºN and longitude of 74·58ºE. The altitude of place is 300 meter above mean sea level. Annual precipitation is about 1200mm. As shown (Fig.1) the mean annual maximum and minimum temperature was 29.60ºC and 16.70ºC respectively. The winter month experiences mild to severe cold and temperature ranges from 6.5ºC to 21.70ºC. December is the coldest month with minimum temperature and evaporation rate goes low as 4.0ºC, however the maximum, minimum temperature and evaporation rate rises from March onwards.

The seedling used was one and half year old having uniform vigour and of pencil thickness at the time of budding. Budding was performed in the month of spring season (February-March) and the budded plants were planted in different sizes of black polybags and in the open field. The field design was maintained in tri-replicated were executed in factorial randomized block design (RBD).Physico-chemical analysis presented in Table 1 reveals that mechanical analysis of soil carried out by International dispersion method (Piper, 1950) shows percentage of sand, silt and clay as 68.5%, 18.5% and 13% respectively in experimental soil. Chemical analysis carried out by different methods as pH and electrical conductivity (dsm^{-1}) by 1:2 soil water suspension (Jackson,

1973) methods showed pH 7.5 and electrical conductivity 0.11 dsm^{-1}, organic carbon by Walkley and Blacks method was found to be 0.58%, available nitrogen by potassium permanganate method (Subbiah and Asija, 1956) was 230.15 $Kg\text{-}ha^{-1}$, available phosphorous (Olsen method) (Olsen *et al.*, 1954) was 14.45 $Kg\text{-}ha^{-1}$, available potassium (Flame Photometer method) was 140.5$Kg\text{-}ha^{-1}$, available calcium (EDTA method) was 6.04 $Kg\text{-}ha^{-1}$ and available Mg (EDTA method) was found to be 2.65 meq/100g).

Status of NPK in Farm Yard Manure and Vermicompost presented in Table 2 showed that in FYM percentage of N, P and K was 0.50%, 0.20% and 0.50% respectively. In vermicompost percentage of N, P and K was 2.01%, 1.10% and 0.50% respectively. Table 3 shows four different size of polybags viz. C_1 Polybag with holes of size 25×13×10 cm, C_2 Polybag with holes of size 22×10×8 cm, C_3 Polybag with holes of size 17×7×6 cm and C_4 nursery bed (Size = 1×1 m) filled with six different propagation medias as shown in Table 4viz. M_1 soil: FYM 2:1, M_2 soil: sand: FYM 1:1:1, M_3 soil: sand: FYM 2:1:1, M_4 soil: vermicompost 2:1, M_5 soil: sand: vermicompost 1:1:1 and M_6 soil: sand: vermicompost 2:1:1.

The observation on days taken for the first leaf sprout was calculated by observing the plants on alternate days from the day of budding and the number of days taken for sprouting was recorded as the days taken for first leaf sprout. Average leaf area was calculated after 180 days after budding with the help of non-destructive type of Laser leaf area meter by taking randomly ten fully grown and physiologically matured leaves. After washing the soil ball total number of primary roots arising from the main stem from the five plants after six months of planting and the average was calculated as the number of primary roots per plant. The total number of roots arising from the primary roots was counted from the randomly selected five plants of each replication of the treatment after six months from planting and the average was calculated as the number of secondary roots per plant.After six months of out planting these budded kinnow plants were accessed for their field performance by calculating the out planting performance (survival per centage) in the open field.

$$\text{Survival percentage} = \frac{\text{No. of plants survived}}{\text{Total no. of plants planted}} \times 100$$

Organic carbon in soil was determined by Walkley and Black's method,available nitrogen was estimated by using alkaline $KMNO_4$ method, available phosphorus content of the soil was extracted with sodium bicarbonate and the blue colour intensity was measured colorimatically at 660 nm wavelengths, available potassium was determined in the neutral normal ammonium acetate extract of soil through Flame Photometer. The data generated during the course of study was subjected to statistical analysis as prescribed by Panse and Sukhatme(2000).

RESULTS AND DISCUSSION

As shown in Table 5 the interaction effect of different types of potting materials and propagation media on number of days taken to sprouting was significant and theminimum days 13.50 for first leaf sprout was recorded in potting material of black poly bag with holes of size 22x10x8 cm filled with propagation media containing soil: sand: vermicompost in ratio 1:1:1. These findings are in consonance with Singh *et al.*(2004) where they observed that container grown buddlings of kinnow plants exhibit maximum budding success sprout length, number of leaves than open field conditions.

Perusal of the data in Table 5 indicates that interaction effect of potting material and propagation media has significant effect on leaf area.The maximum leaf area 15.21 cm^2 was observed in potting material of black poly bag with holes of size 22x10x8 cm filled with the propagation media soil: sand: vermicompost in the ratio 1:1:1. The increase in the leaf area might be attributed to the conducive effect of this medium mixture on water holding capacity, porosity, soil aeration and supplying

Table 1: Physico-chemical analysis of experimental soil.

S.No.	Parameter	Test value	Methods employed
(A)	Mechanical Analysis		
1	Sand (%)	68.5	
2	Silt (%)	18.5	
3	Clay (%)	13	International dispersion method (Piper, 1950)
(B)	Chemical Analysis		
1	pH	7.5	
2	Electrical conductivity (dsm^{-1})	0.11	1:2 Soil water suspension (Jackson, 1973)
3	Organic Carbon (%)	0.58	Walkley and Blacks Method
4	Available Nitrogen ($Kg\text{-}ha^{-1}$)	230.15	Alkaline Potassium Permanganate Method (Su (Subbiah and Asija,1956)
5	Available phosphorous ($Kg\text{-}ha^{-1}$)	14.45	Olsens Method (Olsen *et al.* 1954)
6	Available potassium ($Kg\text{-}ha^{-1}$)	140.5	Through Flame Photometer (Mervin and Peech, 1951)
7	Available calcium ($Kg\text{-}ha^{-1}$)	6.04	EDTA method
8	Available Mg (meq/100g)	2.65	

The data presented in Table 1 indicates that the texture of the soil was sandy loam and soil was neutral in reaction. The available nitrogen was in low range with available phosphorous and potassium in medium range

Table 2: Status of NPK in Farm Yard Manure and Vermicompost

S.No	Particulars	N (%)	P (%)	K (%)
1	FYM	0.50	0.20	0.50
2	Vermicompost	2.01	1.10	0.50

Nutrient composition of different organic manures used in preparation of media was given below

Table 3: Details of the container type (black polybags) and their volume/size used for the study

Levels	Container type	Volume/ size
C_1	Polybag with holes	25×13×10 cm
C_2	Polybag with holes	22×10×8 cm
C_3	Polybag with holes	17×7×6 cm
C_4	Nursery bed (Size =1×1 m)	(20×20 cm)(25 No. of plants)

Table 4: Details of potting mixture and their proportions used for the study

Levels	Media	Proportion
M_1	Soil: FYM	2:1
M_2	Soil: Sand: FYM	1:1:1
M_3	Soil: Sand: FYM	2:1:1
M_4	Soil: Vermicompost	2:1
M_5	Soil: Sand: Vermicompost	1:1:1
M_6	Soil: Sand: Vermicompost	2:1:1

substantial amount of nutrient specially nitrogen and micro nutrients for good root and shoot growth over control Chopde *et al.* (1999). These results corroborates with the results of Tingson (1991) who studied the growth response of calamansi(*Citrus madurensis*Lour) rooted cuttings to varying proportions of potting media and different sizes of containers.

The interaction effect of different types of black poly bagsand propagation media in Table 5 also presents that the number of primary roots was recorded maximum 12.00 in black poly bag with holes of size 22x10x8 cm filled with propagation media of soil: sand: vermicompost in the ratio of 1:1:1. The beneficial effect on root growth parameters due to application of the medium soil: sand: vermicompost in the ratio of 1:1:1 might be due to improved soil conditions, activity of useful soil micro fauna and flora, maintained soil temperature, improved soil health and nutrient status of medium. These results are in agreement with Hartmann and Kester(1997) vermicompost also provides close contact between root and media, increases steady moisture supply facilitates root respiration and encourages overall root growth Chatterjee and Choudhuri(2007).

Interaction effect of different black poly bags and propagation media shows that maximum number of secondary roots(99.67 was obtained in black polythene bag with holes of size 22x10x8 cm filled with propagation media of soil: sand: vermicompost in the ratio of 1:1:1 presented in Table 5. This increase was higher as it appears that the beneficial effects of reduced root restriction in larger containers are enhanced at higher nitrogen levels which are present in vermicompost based media. Similar results are also in accordance with Reddy *et al.* (2001) in evaluation of potting mixture for raising coconut seedling in poly bag.

Interaction effect of different black poly bags and propagation media in Table 5also showed significant results among all the treatments tried for out planting performance (survival percentage) after one year of budded kinnow plants under open field conditions. Highest out planting performance (survival percentage) of 93.33 percent was obtained in black poly bag with holes of size 22x10x8 cm filled with propagation media soil: sand: vermicompost in the ratio 1:1:1 The results are in conformity with Nayital *et al.* (1995) where they observed that pure soil and sand with low water holding capacity resulting into poor root growth. They further observed that black poly bags influences all the growth parameters due to container volumes which reduced root restriction and led to increased dry matter production resulting in increased survival percentage. Vizzotto *et al.*(1993) also observed that reduced root restriction in large containers increased soil volume exploited by roots and hence nutrient uptake, hormone synthesis and metabolism in the root system.

The data analysed in Table 6 showed significant results on the interaction effect of different black poly bagsand propagation media, the maximum organic carbon 0.82 percent was recorded inblack poly bag with holes of size 22x10x8 cm filled with propagation media soil: sand: vermicompost in the ratio of 1:1:1. Abirami *et al.* (2010)also reported maximum organic carbon in propagation media containing vermicompost as compared to media containing FYM.

The interaction effect of different black poly bags and propagation media on nitrogen in soil of budded kinnow plants after six months of planting significantly increased the nitrogen levels in the soil where maximum nitrogen content 299.00 $kgha^{-1}$ was recorded in black poly bag with holes of size 22×10×8 cm filled with soil: sand: vermicompost in the ratio of 1:1:1 as shown in Table 6. Similar results were observed by Theunissen*et al.*(2010) who reported increased nitrogen rates in vermicompost than FYM. It has been confirmed that vermicompost has the capacity to supply both added macro and micronutrients in the soil for optimum plant growth Harris *et al.*(1990). These plant nutrients are adsorbed on the humic acid molecules and are released slowly and gradually into the soil solution and made available for plant growth and development processes. Thus the growth characteristics of

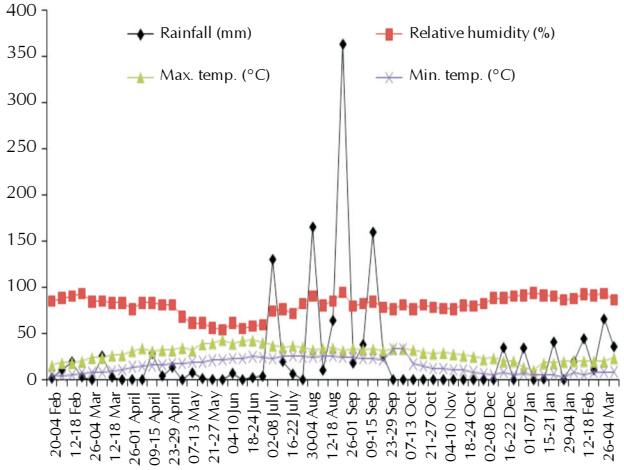

Figure 1: Meteorological observation on weekly intervals during 2012-13

Table 5: Influence of different types of potting material, propagation media and their interaction on growth characteristics and out planting performance on budded kinnow plants

Treatment	Days taken for first leaf sprout	Leaf area (cm^2)	No. of primary roots/plant	No. of secondary roots/plant	Out planting performance (Survival percentage)
Black polybags					
C_1	19.40	14.88	7.89	66.17	58.89
C_2	17.81	14.96	9.00	73.28	67.78
C_3	18.29	14.92	8.44	67.83	62.22
C_4	19.86	14.84	7.33	63.33	55.00
C.D	0.01	0.02	0.10	1.52	1.84
Potting mixtures					
M_1	22.32	14.73	4.83	50.50	40.83
M_2	19.30	14.88	8.33	65.58	59.17
M_3	19.61	14.87	8.00	63.67	55.83
M_4	20.71	14.79	6.17	56.75	46.67
M_5	15.26	15.09	11.00	87.33	83.33
M_6	15.85	15.05	10.67	82.17	80.00
C.D	0.02	0.02	0.13	1.86	2.26
Black polybags x Potting mixtures					
C_1M_1	22.70	14.72	4.67	48.67	40.00
C_1M_2	19.70	14.86	8.00	63.00	56.67
C_1M_3	20.00	14.85	7.67	62.33	53.33
C_1M_4	21.00	14.79	6.00	56.67	46.67
C_1M_5	16.20	15.05	10.67	83.67	80.00
C_1M_6	16.80	15.02	10.33	82.67	76.67
C_2M_1	21.60	14.75	5.33	53.67	43.33
C_2M_2	18.30	14.94	9.33	72.67	66.67
C_2M_3	18.90	14.92	9.00	69.67	63.33
C_2M_4	20.70	14.80	6.67	58.33	50.00
C_2M_5	13.50	15.21	12.00	99.67	93.33
C_2M_6	13.90	15.15	11.67	85.67	90.00
C_3M_1	22.00	14.74	5.00	51.67	40.00
C_3M_2	19.10	14.90	8.67	64.67	60.00
C_3M_3	19.50	14.88	8.33	63.33	56.67
C_3M_4	20.09	14.80	6.33	58.00	46.67
C_3M_5	14.04	15.11	11.33	85.00	86.67
C_3M_6	15.00	15.08	11.00	84.67	83.33
C_4M_1	23.00	14.71	4.33	48.00	40.00
C_4M_2	20.10	14.83	7.33	62.00	53.33
C_4M3	20.03	14.82	7.00	59.33	50.00
C_4M_4	21.04	14.77	5.67	54.00	43.33
C_4M_5	17.30	14.98	10.00	81.00	73.33
C_4M_6	17.70	14.96	9.67	75.67	70.00
C.D	0.03	0.04	0.26	3.72	4.50

budded kinnow plants are highest in vermicompost based interaction than FYM. Differences in the nitrogen contents might be due to variation in organic matter contents in the different components of potting media.

Similarly, interaction effect of different black poly bagsand propagation media on soil phosphorous was also found maximum 20.78 $kgha^{-1}$ in black polybag with holes of size 22x10x8 cm filled with propagation media soil: sand: vermicompost in the ratio of 1:1:1 as presented in Table 6. These findings were in accordance with Theunissen*et al.* (2010) who reported that phosphorous content in vermicompost is more as compared to FYM which result in their maximum uptake for plant development.

Interaction effect of different black poly bags and propagation media shown in Table 6significantly increased the soil potassium contents. Soil potassium was found maximum 146.77 $kgha^{-1}$) at 180 days after transplanting in black polybag with holes of size 22x10x8 cm filled with propagation media soil: sand: vermicompost in the ratio of 1:1:1. Similar findings were in consonance with Theunissen *et al.* (2010) who reported that vermicompost contain more amount of potassium and is easily available for plant development.

Interaction effect of different black poly bags and propagation media showed significant results as presented in Table 6, where maximum calcium content in soil 6.70 meq/100g was obtained in black polybag with holes of size 22x10x8 cm filled with propagation media containing soil: sand: vermicompost in the ratio 1:1:1. Similarly, magnesium content was also found maximum 3.28 meq/100g in black polybag with hole of size 22x10x8 cm filled with propagation media containing soil: sand: vermicompost in the ratio of 1:1:1.

From the above discussion it may be concluded that growth and survival of kinnow plant was maximum in black polybags with holes of size 22x10x8 cm filled with propagation media

Table 6: Influence of different types of potting material, propagation media and their interaction on soil characteristics of budded kinnow plants after six months of planting

Treatment	Organic carbon (%)	N(kgha^{-1})	P(kgha^{-1})	K (kgha^{-1})	Ca (meq/100g)	Mg (meq/100g)
Black polybags						
C_1	0.75	273.50	18.04	156.00	6.50	3.15
C_2	0.76	278.22	18.44	161.83	6.72	3.26
C_3	0.74	278.83	17.17	159.00	6.62	3.22
C_4	0.74	271.50	17.62	153.50	6.56	3.18
C.D	0.01	3.35	0.05	1.37	0.02	0.02
Potting mixtures						
M_1	0.72	254.50	16.20	142.25	6.18	3.06
M_2	0.75	276.25	17.91	158.25	6.59	3.20
M_3	0.75	276.50	17.68	157.00	6.55	3.18
M_4	0.68	263.25	15.27	148.00	6.39	2.98
M_5	0.80	292.50	20.08	170.92	6.97	3.41
M_6	0.79	290.08	19.79	169.08	6.91	3.38
C.D	0.01	4.10	0.66	1.68	0.02	0.02
Black polybags x Potting mixtures						
C_1M_1	0.72	254.00	16.25	142.00	6.42	3.07
C_1M_2	0.75	275.00	18.15	157.00	6.60	3.22
C_1M_3	0.75	273.00	17.95	155.00	6.57	3.19
C_1M_4	0.68	262.00	15.38	147.00	6.20	2.99
C_1M_5	0.80	290.00	19.25	168.00	6.80	3.35
C_1M_6	0.78	287.00	18.92	167.00	6.75	3.31
C_2M_1	0.73	258.00	16.59	144.00	6.45	3.09
C_2M_2	0.77	281.00	18.75	162.00	6.70	3.28
C_2M_3	0.74	269.00	18.45	163.00	6.63	3.26
C_2M_4	0.69	266.00	15.52	150.00	6.26	3.01
C_2M_5	0.82	299.00	20.78	177.67	7.18	3.45
C_2M_6	0.81	296.33	20.56	174.33	7.09	3.44
C_3M_1	0.70	256.00	15.89	143.00	6.32	3.03
C_3M_2	0.74	278.00	17.10	160.00	6.51	3.12
C_3M_3	0.77	284.00	16.90	158.00	6.48	3.11
C_3M_4	0.66	265.00	14.98	149.00	6.11	2.95
C_3M_5	0.78	296.00	20.38	173.00	7.00	3.43
C_3M_6	0.79	294.00	20.12	171.00	6.95	3.41
C_4M_1	0.67	250.00	15.20	140.00	6.15	2.97
C_4M_2	0.75	271.00	17.65	154.00	6.55	3.16
C_4M3	0.74	280.00	17.40	152.00	6.53	3.14
C_4M_4	0.71	260.00	16.05	146.00	6.38	3.05
C_4M_5	0.79	285.00	19.89	165.00	6.90	3.39
C_4M_6	0.80	283.00	19.54	164.00	6.85	3.37
C.D	0.02	8.21	0.13	3.35	0.04	0.04

of soil: sand: vermicompost in the ratio 1:1:1.

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