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Effects Nursery Media on *Irvingia gabonensis* and *Dacryodes edulis* Seedlings and Weed Dynamics of the Media

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ABSTRACT

A field experiment was conducted to assess the effect of different nursery media on performances of Bush mango (*Irvingia gabonensis)* and African pear (*Dacryodes edulis)* seedlings. Five nursery media were formulated from topsoil, poultry manure and river sand in the following ratios; 0:3:3, 1:2:3, 1:3:2, 2:3:1 and 3:2:1. The media formulated were analyzed for the physico-chemical properties and seeds of the test crops were sown in each filled polythene bags with the formulated media. The experiment was arranged in a completely randomized design (CRD). The results obtained show significant (P≤0.05) media effects on days to first and 50% seedling emergence and percentage total emergence in Bush mango but non-significant in African pear. Number of days to last seedling emergence was significantly (P≤0.05) influenced by media in African pear leaf number and plant height for 10 weeks were responsive to differences in media in both crops. Media influenced total dry weight only in Bush mango while dry matter distribution pattern varied significantly in African pear. In both crops, percentage total seedling emergence and seedling vigour were better in medium 1:2:3. Therefore, from the results, the differential influence of media on seedling growth as evidence in the study suggested the need for broader evaluation of media for different tropical tree species to identify the most appropriate medium for each species that will ensure better vigorous seedling production for plantation and/or orchard establishment. Also, the results showed significant variation in weed flora composition, comprised of 35 species made up of 14 families. The families of *Asteraceae, Gramineae, Amaranthaceae and Acanthaceae* were predominant. Annual weed species and broadleaf were predominant.

1. Introduction

Bush mango is indigenous non-timber forest product in West and Central Africa especially in Southern Nigeria (Ladipo, 2000). The most important part of I. *gabonensis* to the rural people in various communities in eastern part of Nigeria is its nutritious seeds which have also been found useful in the reduction of cholesterol and body weight in obese patients (Omokhua *et al.*, 2012). The seeds are popularly used as a condiment (soup thicker) and are responsible for the characteristic appetizing flavour of the Nigeria ogbono soup. The mesocarp or pulp is consumed locally as a fresh fruit by farming households and as a major source of vitamin C and beta-carotene while environmentalists use the trees as windbreak (Kengni, 2011). Bush mango is a valuable source of income for farmers and traders in Nigeria where the fruit is traded locally (Ladipo, 2000). The kernels, which fetch higher prices than the fruits are traded regionally and internationally, which has given it the potential for a true commercial crop, and this has led to more intensive collection in the forests.

African pear or plum is a native to west forest zone of Africa and some limited parts of Asia. It is cultivated Malaysia and some other regions of humid tropical Asia (Udoh & Ndon, 2016). African pear is popular fruit salad, especially in southern Nigeria where a large number of varieties of different sizes and shapes exist. The mescarp (fruit) is eaten raw, softened with hot or warm water. It could be slightly roasted and usually eaten with maize. Pear has high fat/oil content. The fruit has higher potential quality of edible oil. The fruit oil contains mostly palmitic and oleic acid which make up to 47 to 60% of fat. The plant has good quality gum in its trunks.

Fruit trees are usually Orchards and plantation of tree species are commonly established with seedlings in the nursery (Baiyeri, 2002). This is done to ensure economy of seeds and proper management. However, the quality of seedlings raised in the nursery is significantly influenced by the growth medium because plant roots are limited by the size and content (moisture, nutrient, air and texture) of the nursery container. Growing media are an integral part of most horticultural production systems. Nursery media are the substrates in which plants will grow, media provide plant's anchorage, air spaces to allow respiration and retain sufficient available water to enable plant growth. According to Majekodunmi *et al.*, (2021), growing media are materials that plants grow in, specifically designed to support plant growth and can either be a solid or a liquid. Different components are blended to create homemade and commercial growing media and different types of growing media are used to cultivate various plants Materials commonly used in the formulation of growth media in Nigeria are cocoa shells, sewage sludge, sugar cane waste, saw dust, banana trunk and bunch biomass by product, leaf mould, straw products, loam sea weed, hop waste, wood waste, spent mushroom compost, rice hulls, poultry droppings, dungs, pig excreta, kitchen waste, market refuse, effluents, wood ash etc. Growing medium is known to affect plant performance in bare roots and container nursery production (Gajalakshmis, 2012).

Nursery medium have been found to influence the emergence and growth of seedlings and it is therefore necessary to find a suitable medium that will enhance its vigour. It is necessary to find a suitable soil mix that would encourage vigorous root and shoot growth in the nursery before transplanting to permanent site. This assists in selection of healthy and vigorous seedlings for plantation or orchard establishment.

Seedling production is an important step in the horticultural production system because it influences fruits and vegetables' yield. Growing media is a major factor that influences seed germination, seedling emergence, seedling growth and quality of seedlings in a nursery (Aklibasinda *et al.*, 2011; Unal, 2013). The quality of the growing media used in containerized seedling production is largely influenced by physical, chemical and biological properties (Herrera *et al.*, 2008), the growing environment and plant management (Nwofia & Okwu, 2015). Growing media is not only a place where seeds are sown and seedlings raised, but is also a source and reservoir of plant nutrients (Indriyani *et al.*, 2011). It also anchors the root system and therefore supports the plant (Abad *et al.*, 2005). A good growing media should be composed of mixtures that are tender enough for seeds to easily germinate, retains moisture, drains excessive water and provide sufficient plant nutrients for seedling growth and development (Olle *et al.*, 2012; Olaria *et al.*, 2016).

Several growth media had been evaluated on various plants by previous researchers (Manenoi *et al.*, 2009; Indriyani *et al.*, 2011; Bhardwaj, 2013; Kumar *et al.*, 2016). A wide range of growth media or substrates of different origin are used in vegetable production. Some media are of natural origin while others are produced artificially in factories (Olle *et al.*, 2012; Bhat *et al.*, 2013). Growth media can include organic materials such as peat, compost, tree bark, coconut fiber, vermicompost, rice husk ash, or inorganic materials such as perlite and vermiculite (Nair *et al.*, 2011; Vaughn *et al.*, 2011). The growth media from organic derivatives are usually used in greenhouses to form bedding plants and vegetable transplants (Atiyeh *et al.*, 2000). Mineral soil or sand is also used for growing vegetables (Olle *et al.*, 2012; Mathowa *et al.*, 2014a) and tree seedlings (Sekepe *et al.*, 2013; Mathowa *et al.*, 2014b; Mathowa *et al.*, 2014c). Growth media provide aeration and water, enhance root growth and physically support the plant (Olle *et al.*, 2012). Organic nursery formulation are usually recommend as the best media for improving seedling growth and root development, thereby reducing the use of chemical inputs such as agro-chemicals (fertilizer and pesticides) which have caused environmental pollution and soil degradation. Concerns over unfriendly environment and public health have prompted agricultural and environmental scientists to reevaluate the practices in modern soil management and crop production.

Recently, alternative production systems such as environment-friendly agriculture, ecological sound agriculture, organic agriculture and nature farming have received great attentions globally. However, many questions are faced by farmers and agricultural scientists. Most of alternatives to chemical crop production practices have to be tried and tested in organic based. Weed control is one of the most important cultural practices in crop production, followed by disease and pest management in nature or organic farming. Relatively, little or no attention has been devoted to the influence of weeds in the nursery media. Weeds are the most under estimated crop pests, which causes serious economic losses in crop yields. Weeds makes crop production tedious, it interfere with farming operations, harbours insect pests and increase cost of farm operations. Also, most weeds had grown resistance with herbicides making its control difficult (Derr *et al.*, 2020; Boyd & Steed, 2021)**.**

Various researchers have found out that as little as one weed in a container or a small pot affects the growth of a crop (Khamare *et al.*, 2023), but this is highly dependent on weed and crop species present. For example, one large redroot pigweed (*Amaranthus retroflexus*) or large crabgrass (*Digitara sanguinalis*) plant per pot reduces the growth of convexa Japanese holly (*Hexcrenata*) by 47% and 60%, respectively. Even if weeds do not reduce growth, a container plant with weed is a less marketable product than a weed free product. Weed management in pot mixture or in a container nursery involves controlling weeds and preventing their spread. Unlike pest and disease control, for weed control, there is no alternative of herbicides. Integrated weed control practices combined with cultivation measures have been tried and adopted in organic agriculture. Integrated weed control should have a broader focus than weed control alone and should be integrated with other crop production practices that affect the ecosystems. These measures include planting time, crop residual mulching, intercropping, row spacing and mechanical weeding. Organic mulch material particularly effective in mechanical and biochemical (allelopathic) weed suppression. Studies on cultural method of weed control particularly the use of organic mulch materials is comparatively fewer. The influence of organic mulch materials in suppressing weeds to achieve minimum weed competition is still poorly understood in the tropics. However, weed suppression was effective when organic mulch materials were used; and effectiveness and efficiency depends on the type of mulch materials persistence, thickness of mulch cover and environmental conditions (Ikeh *et al.*, 2018; Ikeh *et al.*, 2019)**.**

Organic mulch suppresses weeds by inhibition of weed seed germination and suppression of their growth and development (Ikeh *et al.*, 2018), although it has not been demonstrated as weed suppressants in a nursery media pot or container. Therefore, this study was carried out to envisage the potential of locally formulated nursery media on seed germination and seedling performance of bush mango (*Irvingia gabonensis*) and African pear (*Dacryodes edulis*) in Unwana, southeastern Nigeria.

In Nigeria today, the demand for healthy seedlings of both crops is high. Commercial plantation farmers are now interested in these tree crops. The use of good and healthy seedlings in the establishment of plantation crops has been reported to improve the yield. Raising seedlings in an open field has not been successful provide the need for high quality seedlings, the reasons could as a result of inability to control the soil nutrient requirement in open field, protection against pest and dieses. Loss of nutrient through leaching, trampling the leaves and terminal buds by animals etc. Therefore, the study was carried out in an experimental station under close monitory and observation to assess the effect of different nursery media on performance of both indigenous fruits seedlings and to determine the weed infestation level in different growing media.

2. Materials and methods

2.1 Experimental site

The experiment was conducted in the greenhouse of the Demonstration and Research farm of the Department of Horticulture and Landscape Technology, Akanu Ibiam Federal Polytechnic, Unwana, Afikpo, Ebonyi State, Nigeria. Unwana is located at Latitude $5^0 48^1$N and Longitude $7^0 55^1$E with altitude of 400m above sea level (NIMET, 2013). The area is located within the southern rain-forest zone. The climate of the area is tropical humid with high temperatures and high humidity. The maximum temperature is 29^0C, while the minimum temperature is 23^0C. The climate is characterized by two distinct seasons namely; rainy and dry seasons with an annual rainfall of 1200mm – 1500mm. The vegetation of the area has been described as derived savanna (Essien *et al.*, 2009).

2.2 Media Formulation and Filling of Polythene bags

Five media formulations comprising of topsoil, poultry manure and river sand in the ratios (0kg:3kg :3kg), (1kg : 2kg: 3kg), (1kg: 3kg: 2kg), (2kg: 3kg: 1kg) and (3kg: 2kg: 0kg), respectively were used for the study. These formulated media were bagged in 40 x 60cm black polythene bags perforated at the bottoms and left for two weeks before planting.

2.3 Experimental design and Treatment

The experimental design used was completely randomized design (CRD), with five treatments replicated three times.

2.4 Seed sowing

Seeds of Bush mango and African pear were carefully extracted, and only viable seeds determined by floatation method were planted. Six seeds were sown in each bag after incubation period. The two crops were evaluated independently.

2.5 Data collection and Analysis

Crop data collected included; number of days to first seedling emergence, 50% and last seedling emergence and percentage total emergence. Growth measurements were done at two weeks intervals for 10 weeks and parameters assessed included; number of leaves, plant height, stem girth and dry matter distribution. Dry matter production and distribution pattern were estimated at 20 weeks after planting for both crops. Seedlings uprooted were partitioned into root, stem and leaves and were oven dried at about 75^{0}C until constant dry weight obtained. Data collected were subjected to analysis of variance (ANOVA) and the means separated using least significant difference (LSD $p<0.05$).

2.6 Weed composition collection

The composition of weed(s) flora on the polybags were identified and counted.

3. Results and discussion

3.1 Effect of media on the emergence pattern of bush mango and african pear

Results obtained (Table 1) shows that media significantly ($p\leq0.05$) influenced the number of days to first seedling emergence. Among the treatments used, media formulation of 2: 3: 1 produced the highest seedling emergence (40.0%) while 1: 2: 3 media produced the least number of seedlings (21.0%) in Bush mango, respectively. In contrast, result revealed that, total emergence at the last day was 73.3% with media formulation of 1: 2: 3, while media with 2: 3: 1 produced the least (26.7%) seedlings of Bush mango, representing 0.05 – 13.25% and 9.00 – 63.57%, respectively. However, at 50% days to seedling emergence, there was no significant ($p\leq0.05$) difference among the treatment used. Results (Table 1) shows that media formulation of 1: 3: 2 had the highest seedling emergence (33.0%), while 1: 2: 3 had the least seedling emergence (25.5% in African pear tree crop. The total percentage emergence on the last day was significantly better. Media 1: 2: 3 produced the highest seedlings (80.0%), while the least of 44.0% seedlings emerged at media 1: 3: 2 and 2: 3: 1, respectively; representing 5.15% - 22.72% and 8.38 – 45.0%, respectively.

Table 1. Effect of Media on the emergence pattern of Bush mango and African pear

Media	First	Last	50%	Total emergence (%)
Bush mango				
0:3:3	20.00	24.70	31.70	46.70
1:2:3	15.00	21.00	28.30	73.30
1:3:2	18.00	23.30	27.70	66.70
2:3:1	34.70	40.00	40.00	26.70
3:2:1	21.00	34.70	36.30	50.00
LSD ($_{0.05}$)	**10.0**	**10.5**	**Ns**	**22.8**
African pear				
0:3:3	25.40	31.30	41.80	62.00
1:2:3	17.70	25.50	35.50	80.00
1;3;2	30.90	33.00	62.60	44.00
2:3:1	21.70	29.50	48.40	44.00

3:2:1	19.3	27.8	43.3	73.30
LSD($_{0.05}$)	**Ns**	**Ns**	**1.5**	**Ns**

3.2 Effect of Media on Growth Parameters of Bush mango and African pear

Results obtained (Table 2) shows the effect of nursery media on growth parameters of fruit tree crops. The result indicated a significant ($p \leq 0.05$) difference among the treatment used. At 10 weeks after planting (WAP), media formulation of 3: 2: 1 produced the highest leaf number and tallest plant while 0: 3: 3 treatment produced the least number of leaves and shortest plant of bush mango. Media treatment, 2: 3: 1 produced the biggest stem (0.52cm) while 0: 3: 3 and 1: 2: 3 had the smallest stem (0.4cm), respectively. Results also revealed that, African pear had the highest leaf number (7.75), tallest plant (19.54cm) and biggest stem (0.48cm) with media of 3: 2: 1, while media of 0: 3: 3 produced the least across the treatments, representing 3.6 – 34%, 5.6 – 28.3% and 2.08 – 14.6%, respectively.

Table 2. Effect of Media on Growth Parameters of Bush mango and African pear at10 Weeks after Planting

Media	Number of leaves per plant	Plant Height (cm)	Stem Girth (cm)
Bush Mango			
0:3:3	4.0	14.50	0.40
1:2:3	4.3	17.20	0.40
1:3:2	5.50	19.80	0.43
2:3:1	5.80	19.80	0.52
3:2:1	6.00	22.40	0.48
LSD($p<0.05$)	0.20	0.71	0.07
African Pear			
0:3:3	5.0	14.01	0.41
1:2:3	7.09	17.21	0.47
1:3:2	7.74	18.40	0.48
2:3:1	7.47	19.43	0.47
3:2:1	7.75	19.54	0.48
LSD($p<0.05$)	0.20	2.10	0.007

Dry weight of bush mango seedlings grown in medium 1: 2: 3 were in all cases more than 100% higher than seedlings grown in the other media (Table 3). Dry matter distribution pattern was statistically similar. Seedlings grown in media 1: 2: 3 partitioned the highest (50.77%) proportion of its dry matter to leaf as against 40.99% partitioned to leaf seedlings grown in medium 0: 3: 3, representing 5.73 – 19.26%. media did not significantly influence total dry weight and dry matter content of African pear seedlings (Table 3). However, the quantity of photosynthetic partitioned to leaf and stem varied with media. Dry matter to the leaf was highest (59.33%) in media 2: 3: 1 followed by media 1: 2: 3 with 58.47%. dry matter partitioned to the stem was highest when seedlings were grown in medium 3: 2: 1. However, seedlings grown in medium 0: 3: 3 had higher proportion of dry matter partitioned to the root, representing 1.45 – 1.63%, 5.13 – 24.57% and 6.93 – 20.33%, respectively.

Table 3. Effect of Media on Total dry weight, percentage total dry matter production and dry matter distribution in Bush mango and African pear seedlings 20 weeksafter planting

	Total Dry Weight (g)	Total Dry Matter (%)	Dry Matter Accumulation in Leaf (%)	Dry Matter Accumulation in Stem (%)	Dry Matter Accumulation in Root (%)
Bush Mango					
0:3:3	7.33	28.02	40.99	36.95	22.07
1:2:3	37.33	33.63	50.77	36.14	13.09
1:3:2	16.00	24.50	41.31	43.03	15.66
2:3:1	5.33	26.78	47.86	32.89	19.25
3:2:1	2.62	21.80	44.75	34.87	21.38
LSD($p<0.05$)	12.99	Ns	Ns	Ns	Ns
African Pear	3.45	32.16	50.73	30.52	18.74

0:3:3	3.59	39.31	58.47	26.60	14.93
1:2:3	2.32	31.41	49.57	31.82	18.61
1:3:2	2.82	26.01	59.33	25.30	15.37
2:3:1	3.68	32.60	49.66	33.54	16.80
LSD($p<0.05$)	Ns	Ns	1.67	5.07	Ns

*Ns =Not Significant

Results obtained (Table 4) shows weed flora composition. The result shows that weed flora composition comprised 35 species made up of 14 families. The families of *Asteraceae, Gramineae, Amaranthaceae* and *Acanthaceae* represented with percentage of 31.43%, 14.29%, 11.43% and 8.59%, respectively. Annual weeds species were observed to be predominant (77.14%), while perennial weeds accounted for only 22.86% of the total flora. Broadleaf weeds were predominant (80.00%), grass (14.28%) while sedge constituted only 2.86%. most of the species of weed flora were widespread across the media treatments but with low density.

Table 4. Effect of Media formulation on weed flora composition

Media	**Weed species**	**Common name**	**Family name**	**M**	**FQ**	**Life cycle**
0:3:3	*Calopogonum mucunoides*	Calopo	*Papilionaceae*	BL	2	A
	Ageratum conyziodes	Goat weed	*Asteraceae*	BL	3	A
	Mimosa pudica	Sensitive plant	*Mimosaceae*	BL	1	P
1:2:3	*Ageratum conyziodes*	Goat weed	*Asteraceae*	BL	3	A
	Eupatorium odoratum	Siam weed	*Compositae*	BL	2	P
	Tridax procumbens	Tridax	*Asteraceae*	BL	1	A
	Physalia argulata	Chinese lantan	*Solanaceae*	BL	4	A
	Panicum maximum	Panicum/carpet grass	*Gramineae*	G	3	A
1:3:2	*Sida acuta*	Sida	*Malvaceae*	BL	1	P
	Oldenlandia corymbosa	Linn	*Rubiaceae*	BL	3	P
	Setaria barbata	Kunth	*Gramineae*	G	1	A
	Ageratum conyzoides	Goat weed	*Asteraceae*	BL	4	A
	Asystasia gangetica	Chinese violet	*Acanthaceae*	BL	3	A
2:3:1	*Ageratum conyzoides*	Goat weed	*Asteraceae*	BL	4	A
	Ageratum houstonianum	Blue bully goat weed	*Asteraceae*	BL	1	A
	Cyperus esculentus	Yellow nutsedge	*Cyperaceae*	G	1	A
	Solenostemon monostachyus	Monkey potatoe	*Lamiaceae*	BL	1	P
	Blepharis maderaspatensis	Water hyacinth	*Acanthaceae*	BL	3	A
	Alternanthera pungens	Khakibur	*Amaranthaceae*	BL	3	A
	Amaranthus spinosus	Pigweed	*Amaranthaceae*	BL	2	A
	Cyathula prostrate	Pasture weed	*Amaranthaceae*	BL	1	A

3:2:1	*Ageratum conyzoides*	Goat weed	*Asteraceae*	BL	5	A
	Amaranthus spinosus	Pigweed	*Amaranthaceae*	BL	3	A
	Aspilia aficana	Hemorrhage plant	*Asteraceae*	BL	1	A
	Chromolaena odoratum	Siam weed	*Asteraceae*	BL	1	P
	Emila coccinea	Emilia	*Asteraceae*	BL	2	A
	Tridax procumbens	Tridax	*Asteraceae*	BL	1	P
	Euphorbia hirta	Asthma plant	*Euphorbiaceae*	BL	2	A
	Solenostenum monostachyus	Monkey potato	*Lamiaceae*	BL	1	P
	Alternanthera pungens	Khakibur	*Amarnathaceae*	BL	1	A
	Peperomia pellucid	Shiny bush	*Piperaceae*	BL	1	A
	Cyperus esculentus	Yellow nutsedge	*Cyperaceae*	S	2	A
	Axonopus compresus	Carpet grass	*Gramineae*	G	1	A
	Elusine indica	Goose grass	*Gramineae*	G	2	A

M = Morphology, FQ = Frequency of occurrence, A = Annual, P = Perennial

3.3 Discussion

The ratios of topsoil, poultry manure and river sand in the media formulated expectedly constituted differences in physical and chemical properties of the media (Table 1). These physic-chemical properties are reported to have reaching effects on qualities of seedlings produced thereof (Baiyeri, 2002). This is so because, seedlings are largely in the soil or close to the soil, thus the soil environment has a major role in growth and development of seedlings (Olle *et al*, 2012). Containerization limits the quantity of some of the growth resources such as air, moisture and nutrients available to the growing seedlings, therefore, growing medium that will support tree crop seedlings must have sustained and an appropriate blend of moisture/nutrient holding capacity and porosity (to ensure adequate air circulation). This also agrees with the work of Olle *et al* (2012), who stated that growth media provide aeration and water, enhance root growth physically support the plant. This however, shows that, the physical composition of the growing media have a profound effect on the supply of water and air to the growing plant and on the wetting properties of dried out media. In the present study, media varied in sand proportion and organic matter content and consequently, the quantity and availability of air, moisture and nutrient to the seedlings. Seedlings of both tree crops (Bush mango and African pear) grown on media 1: 2: 3 had shorter days in seedlings emergence and were consistently taller and have more leaves per plant probably because the medium had the best blend of physic-chemical properties needed by the two test crops for emergence and growth.

As the seedlings grow, the plant partitioned photosynthates produced into leaves, stem and roots. The growth rate of the young plant is increased by investing a greater percentage of the increased weight in leaves, since the faster the leaf area expands, the greater the increase in light interception and photosynthesis (Baiyeri, 2002). Thus, Bush mango seedling growth in medium 1: 2: 3 which partitioned more than 50% of its dry matter production into leaves also have significantly higher total dry weight.

The species of weed population were generally low among the treatments. However, it was observed that, media formulation of 3:2:1 produced the highest weed population followed by 2:3:1, while 0:3:3 media produced the least (Table 4). The increase in weed flora composition in media 3:2:1 could be attributed to the presence of weed seeds in the topsoil used in larger quantity during media formulation. This indicated that topsoil act as weed seed bank, where germination and spread could easily take place if not controlled. The benefit of residue mulching in cultural weed control, crop growth and yield improvement derives from its effectiveness in suppressing weeds by mechanical and allelopathic means Essien *et al.* (2009), types of mulching material, thickness of the material used in mulching, environmental conditions which might have caused the reduction in some species in the combined treatment (Essien *et al*, 2009). Some species of local weeds such as *Ageratum conyzoides* and *Chromolaena odoratum* across the treatments show high frequency occurrence. It could also primarily be attributed to local weed distribution.

4. Conclusion

The essence of formulation of growth media is to improve crop emergence and seedling growth in a controlled enclosure in view of supplying adequate nutrient and care against some biotic stress as well as to provide a conducive crop growth environment. In the characters assessed, most of the species of weed flora were widespread across the media treatments but with low density and appreciable significance in increasing seedling emergence and growth was observed in media formulation of 3:2;1. The study has shown the need to re-evaluate various growth media to identify the most appropriate medium for tropical indigenous fruits seedlings establishment and subsequent growth.

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