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Effect of growing media and bio fertilizers on seed germination, seedling vigour in cashew (*Anacardium occidentale* L.)

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Abstract
A study was conducted to find out the "Effect of growing media and biofertilizers on seed germination, seedling vigour in cashew (*Anacardium occidentale* L.)" at Cashew Research Station, Bapatla, Andhra Pradesh in the year 2021-22. The experiment was laid out in a factorial randomized block design (FRBD) with two replications containing of twenty four treatment combinations which consists of two factors *viz*., growing media at four levels (M_0: soil + sand +FYM (2:1:1) M_1: soil + sand+ vermicompost (2:1:1) M_2: soil + sand + FYM + cocopeat (2:1:1:1) M_3: soil + sand + vermicompost + cocopeat (2:1:1:1)) and biofertilizers at six levels (B_0: SSP @ 10 g/Bag +N:P: K (19:19:19) @ 5 g/lit (foliar spray) + Formula 4 @ 5g/lit (foliar \spray), B_1: Phosphorus Solubilizing Bacteria, B_2: Vascular Arbuscular Mycorrhizal fungi, B_3: *Pseudomonas fluorescence*, B_4: Arka Microbial Consortium, B_5: *Trichoderma viride*), by adopting standard methodology, observations on germination and growth parameters were recorded.
Interaction effect of growing media contained soil + sand + vermicompost + cocopeat (2:1:1:1) inoculated with bio fertilizer Arka Microbial Consortium (M_3B_4) had recorded highest germination per cent (96.00% at 30 DAS), maximum number of leaves per seedling (7.00 and 9.60 at 30 and 45 DAG respectively), stem girth (1.55 cm and 1.61 cm at 30, 45 DAG respectively), plant height (28.35 cm and 38.95 cm at 30, 45 DAG respectively), chlorophyll content (59.84 SPAD units at 45 DAG), survival per cent of seedlings (95.00% at 45 DAG) were recorded against the lowest germination percentage and growth parameters in the treatment M_0B_0 (soil + sand +FYM (2:1:1) inoculated with SSP @ 10 g/Bag +N:P: K (19:19:19) @ 5 g/lit (foliar spray) + Formula 4 @ 5 g/lit (foliar\spray).

Keywords: Media, bio fertilizers, vigour, cashew, *Anacardium occidentale* L.

Introduction
Cashew (*Anacardium occidentale* L.), an evergreen tree crop belonging to the family Anacardiaceae, is one of the most important commercial plantation and foreign exchange earning crops of the country. It has originated in the semi-arid coastal areas of north-eastern Brazil. In the sixteenth century, traders from Portugal introduced the cashew tree to India and Mozambique and from there it spread further across tropical regions of Africa and Asia. Initially, cashew trees were planted to combat soil erosion in coastal areas, since they are fast growing, tolerate salinity and thrive on sandy soils.
Cashew can grow as high as 15 m and the dwarf types can grow up to 4m. Leaves are simple, glabrous, thick and leathery, oblong to obviate and alternately arranged on shoots. The cashew is andro-monoecious and the two types of flowers (hermaphrodite and staminate) are produced in panicles at the terminal portion of current season shoots. (Malhotra, Hubballi, & Nayak, 2017) [3].
Cashew is a drought tolerant plant which is considered as a dollar earning crop in waste lands. The mean maximum and minimum temperatures required for cashew are 34ºC and 18ºC, respectively. Cashew can be grown under varied rainfall conditions ranging from 500 to 4000 mm and can withstand long period of low humidity or dry spell. It is sensitive to conditions of high atmospheric humidity (≥ 80% RH) for prolonged periods.
Cashew apple derived from a tissue called thalamus or receptacle or stalk present outside the ovary is an edible food rich in vitamin C. It can be dried, canned as a preserve or eaten fresh from the tree. The cashew nut a drupaceous kidney-shaped fruit is exclusively surrounded by a greyish hard coat and attached outwardly to cashew apple, the fat of nut is completely natural and unprocessed which is best for the body. It is especially rich in Linoleic acid (Omega-3) and is least damaging to heart and arteries.

The development and maturity of cashew apple are coherent with the nut maturation.

Since Cashew trees are cross-pollinated and heterozygous, their seedling progenies are not true to the parents necessitating the vegetative propagation. Softwood grafting has been the most commercialized among the different methods of propagation. The growing media are reported to play important role in growth of seedlings, growth of roots and the graft take.

To derive the benefits of different growing medium, they are used in combination with different proportions by the nurserymen, since no individual medium can meet all the requirements of the growing seedlings. However, the proportions of each component in a potting mixture needs to be standardized and many earlier researchers focussed on soil, sand and farm yard manure (FYM). Research on use of vermicompost or cocopeat as one of the components of potting mixture and their beneficial effects particularly in combination of bio fertilizers is scanty.

Further, bio fertilizer preparations containing living cells or latent cells of efficient strains of microorganisms that help crop plants in uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants. Very often microorganisms are not as efficient in natural surroundings as one would expect them to be and therefore artificially multiplied cultures of efficient selected microorganisms play a vital role in accelerating the microbial processes in soil.

In cashew nursery management, low percentage of seed germination, mortality of seedling, low success of grafting, stunted growth of grafts, yellowing of leaves on scion and mortality of grafts are the major problems faced by nurserymen. Since the grafting success and further growth of the graft mainly depends on the health of the rootstock, there is scope for exploiting the beneficial effects of bio fertilizers for enhanced seedling growth and the ultimate graft take.

Keeping the above aspects in view, an experiment is proposed to know the "effect of growing media and bio fertilizers on seed germination, seedling vigour and graft take in cashew with the following objectives.

Objectives

1. To study the effect of different growing media on seed germination, vigour of cashew rootstocks.
2. To study the effect of different bio fertilizers on seed germination, vigour of cashew rootstocks.
3. To study the interaction of growing media and bio fertilizers on seed germination, vigour of cashew rootstocks.

Materials and Methods

The experiment was conducted at Cashew Research Station, Bapatla Andhra Pradesh. It was conducted during the year 2021-2022 and the experiment was laid out in a factorial randomized block design (FRBD) with three replications consisting of twenty four treatment combinations which consists of two factors *viz*., growing media at four levels i.e., M_0: soil+ sand +FYM (2:1:1), M_1: soil + sand+ vermicompost (2:1:1), M_2: soil + sand + FYM + cocopeat (2:1:1:1), M_3: soil + sand+ vermicompost+ cocopeat (2:1:1:1) and bio fertilizers at six levels i.e., B_0: SSP @ 10 g /Bag +N:P: K (19:19:19) @ 5g/lit (foliar spray) +Formula 4 @ 5g/lit (foliar\spray). B_1: Phosphorus Solubilizing Bacteria, B_2: Vascular Arbuscular Mycorrhizal fungi, B_3: *Pseudomonas fluorescence*, B4: Arka Microbial Consortium, B_5: *Trichoderma viride.*

The observations were recorded for days taken for germination percentage, number of leaves per seedling,leaf area per plant (cm^2), internodal length (cm), plant height (cm), stem girth (cm), chlorophyll content(SPAD units), survival percentage of seedlings (%).

Results and Discussion

Significant difference has been observed on the growing media, bio fertilizers and their interaction effects related to germination percentage and all the growth parameters.

Among the growing media maximum germination percentage (93.64%), Maximum number of leaves per seedling (6.09 and 8.87 at 30, 45 DAG respectively), stem girth (1.51 cm and 1.57 cm at 30, 45 DAG respectively), seedling height (26.89 cm and 37.93 cm at 30, 45 DAG respectively), chlorophyll content (52.60 SPAD unit at 45 DAG respectively), survival per cent of seedlings (87.93% at 45 DAG respectively) were recorded in the media soil +sand + vermicompost + cocopeat (2:1:1:1) (M_3) while the lowest values for all these parameters were observed in media M_0 (soil + sand +FYM (2:1:1).

Among the bio fertilizers maximum germination percentage (93.22%), number of leaves per seedling (6.70 and 9.33 at 30, 45 DAG respectively), seedling height (27.50 cm and 37.52 cm at 30, 45 DAG respectively), stem girth (1.53 cm and 1.60 cm at 30, 45 DAG respectively), chlorophyll content (57.04 SPAD units at 45 DAG), survival percentage of seedlings (93.28% at 45 DAG) were recorded in bio fertilizer Arka Microbial Consortium(B_4) while the lowest values for all these parameters were observed in B_0 (SSP @ 10 g /Bag + N:P: K (19:19:19) @ 5 g/lit (foliar spray) + Formula 4 @ 5 g/lit (foliar\spray)).

Interaction effect of media contained soil + sand + vermicompost + cocopeat (2:1:1:1) inoculated with bio fertilizer Arka Microbial Consortium (M_3B_4) had recorded maximum germination percentage (96.00%), maximum number of leaves per seedling (7.00 and 9.60 at 30 and 45 DAG respectively), stem girth (1.55 cm and 1.61 cm at 30, 45 DAS respectively), seedling height (28.35 cm and 38.95 cm at 30, 45 DAG respectively), chlorophyll content (59.84 SPAD unit at 45 DAG), survival per cent of seedlings (95.00% at 45 DAG respectively) while the lowest values for all these parameters were observed in treatment M_0B_0 (soil + sand + FYM (2:1:1) inoculated with SSP@10 g /Bag +N:P: K (19:19:19) @ 5 g/lit (foliar spray) + Formula 4 @ 5 g/lit (foliar/spray).

The biological activity enhances the supply of nutrient content in sufficient amount to the plant. If the conditions is more favourable for the Microorganisms activity due to which convert more organic form to inorganic very effectively and dissolving nutrients and available nutrients to the plants to plants. The plants grown in soil enriched with vermicompost exhibit the positive effects on various growth characters like seed germination, seedling vigour index, shoot length, root length, plant fresh weight and plant dry weight (Khare 2018) [9].

Arka microbial consortium consists of *Azotobacter*+ Phosphorus solubilizing bacteria+ Zinc solubilizing bacteria, hence results can be supported with observations done by Sinish *et al*. (2005) [6] in cashew, Vishwakarma (2013) [7] in acid lime. Joolka *et al*. (2004) [2] reported that the influence of

Azotobacter on the growth of pecanut (*Carya illinoensis* Koch) seedlings. Herle (1998) [10] observed in case of tamarind, maximum number of leaves per plant (24.92) maximum plant height (24.34 cm), better graft union success (88.15%) in the medium containing sand, coir dust, soil and compost in the ratio of 1:1:1:1 (v/v). Bharathi (1997) [1] and Mamatha (1998) [4] reported that a medium consisting of sand, coir dust, soil and compost in the ratio of 1:0.5:1:1 (v/v) has recorded maximum graft union success, highest plant height and maximum number of leaves in cashew. Singh *et al.* (2015) [8] studied that effect of vermicompost and biofertilizer on strawberry and reported that application of vermicompost + *Azotobacter* + PSB + Arbuscular mycorrhiza produced maximum plant height, plant spread, number of leaves, leaf area and yield. Chandu *et al.* (2021) [5] reported similar results that among different combinations 75% RDN+ 25% N through Vermicompost + Arka Microbial Consortium registered highest.

Table 1: Effect of growing media and bio fertilizers on germination percentage, number of leaves per seedling, stem girth (cm), seedling height (cm), chlorophyll content and seedling survival per cent (%) in cashew

Treatment	Germination Percentage	Number of leaves per seedling (No.)		Stem Girth (cm)		Seedling Height (cm)		Chlorophyll Content	Seedling Survival
Media	**30 DAS**	**30 DAG**	**45 DAG**	**30 DAG**	**45 DAG**	**30 DAG**	**45 DAG**	**45 DAG**	**45 DAG**
M_0	89.65(9.52)	5.43(2.53)	8.47(3.07)	1.47	1.53	25.67	35.14	47.91	84.19(9.22)
M_1	91.78(9.63)	5.93(2.63)	8.60(3.09)	1.50	1.57	26.68	36.92	52.11	86.74(9.36)
M_2	89.68(9.51)	5.70(2.58)	8.47(3.07)	1.48	1.55	26.14	35.85	50.00	86.16(9.33)
M_3	93.64(9.72)	6.09(2.58)	8.87(3.14)	1.51	1.57	26.89	37.93	52.60	87.93(9.42)
SE (m) ±	0.002	0.047	0.012	0.001	0.001	0.014	0.301	0.032	0.13
CD at 5%	0.006	0.131	0.033	0.003	0.003	0.040	0.859	0.096	0.36
Bio fertilizers									
B_0	89.53(9.51)	4.85(2.49)	7.73(2.95)	1.44	1.53	24.32	34.97	43.67	79.88(8.99)
B_1	91.99(9.64)	6.35(2.79)	9.13(3.18)	1.50	1.57	27.32	37.09	54.20	90.62(9.57)
B_2	91.09(9.59)	5.73(2.67)	8.73(3.11)	1.49	1.56	26.99	36.78	52.22	88.17(9.44)
B_3	90.94(9.58)	5.65(2.60)	8.53(3.08)	1.49	1.54	26.42	36.52	50.38	82.52(9.13)
B_4	93.22(9.70)	6.70(2.82)	9.33(3.21)	1.53	1.60	27.50	37.52	57.04	93.28(9.70)
B_5	90.35(9.55)	5.45(2.56)	8.13(3.02)	1.46	1.54	25.52	35.88	46.42	83.07(9.16)
SE (m) ±	0.003	0.058	0.015	0.001	0.002	0.017	0.368	0.039	0.15
CD at 5%	0.007	0.162	0.042	0.003	0.005	0.047	1.052	0.117	0.45
Interactions									
M_0B_0	88.00(9.43)	4.40(2.32)	7.60(2.93)	1.42	1.51	23.80	33.56	40.26	79.33(8.96)
M_0B_1	89.89(9.53)	5.80(2.60)	9.00(3.16)	1.49	1.55	26.60	36.01	52.14	89.80(9.52)
M_0B_2	89.25(9.49)	5.40(2.53)	8.60(3.09)	1.47	1.54	26.44	35.81	50.81	87.27(9.39)
M_0B_3	90.45(9.56)	5.40(2.53)	8.40(3.06)	1.48	1.52	25.80	35.19	48.65	73.33(8.62)
M_0B_4	92.14(9.65)	6.40(2.72)	9.20(3.19)	1.52	1.58	26.40	36.23	53.28	92.53(9.67)
M_0B_5	88.21(9.44)	5.20(2.49)	8.00(3.00)	1.44	1.52	25.00	34.03	42.31	82.87(9.15)
M_1B_0	90.02(9.50)	5.00(2.44)	7.73(2.95)	1.46	1.53	24.53	35.22	45.24	81.00(9.05)
M_1B_1	92.86(9.68)	6.60(2.75)	9.13(3.18)	1.51	1.59	27.73	37.64	55.42	90.07(9.54)
M_1B_2	91.56(9.62)	5.80(2.60)	8.73(3.11)	1.50	1.57	27.17	37.11	53.02	87.47(9.40)
M_1B_3	91.50(9.61)	5.80(2.60)	8.53(3.08)	1.49	1.55	26.73	37.01	51.09	85.93(9.32)
M_1B_4	93.56(9.72)	6.80(2.79)	9.33(3.21)	1.54	1.60	28.15	37.95	59.63	92.53(9.67)
M_1B_5	91.20(9.60)	5.60(2.56)	8.13(3.02)	1.47	1.54	25.73	36.56	48.28	83.47(9.19)
M_2B_0	88.00(9.43)	4.80(2.40)	7.60(2.93)	1.43	1.52	24.20	34.91	43.26	79.00(8.94)
M_2B_1	90.12(9.54)	6.20(2.68)	9.00(3.16)	1.50	1.56	27.00	36.21	53.32	89.67(9.52)
M_2B_2	90.00(9.53)	5.60(2.56)	8.60(3.09)	1.48	1.55	26.91	36.07	51.89	87.27(9.39)
M_2B_3	89.78(9.52)	5.60(2.56)	8.40(3.06)	1.48	1.54	26.20	35.87	50.54	85.13(9.28)
M_2B_4	91.20(9.60)	6.60(2.75)	9.20(3.19)	1.53	1.59	27.11	36.94	55.42	93.07(9.69)
M_2B_5	89.01(9.48)	5.40(2.53)	8.00(3.00)	1.45	1.53	25.40	35.12	45.54	82.80(9.15)
M_3B_0	92.13(9.65)	5.20(2.40)	8.00(3.00)	1.47	1.54	24.73	36.18	45.92	80.20(9.01)
M_3B_1	95.12(9.80)	6.80(2.68)	9.40(3.22)	1.52	1.60	27.93	38.51	55.92	92.93(9.69)
M_3B_2	93.56(9.72)	6.13(2.56)	9.00(3.16)	1.52	1.58	27.44	38.12	53.14	90.67(9.57)
M_3B_3	92.04(9.64)	5.80(2.56)	8.80(3.13)	1.50	1.56	26.93	38.01	51.24	85.67(9.30)
M_3B_4	96.00(9.84)	7.00(2.75)	9.60(3.25)	1.55	1.61	28.35	38.95	59.84	95.00(9.79)
M_3B_5	93.00(9.69)	5.60(2.53)	8.40(3.6)	1.49	1.56	25.93	37.82	49.56	83.13(9.17)
SE (m) ±	0.005	0.014	0.030	0.003	0.004	0.034	0.737	0.079	0.31
CD at 5%	0.015	0.042	0.084	0.008	0.011	0.098	2.063	0.225	0.86

Conclusion

Based on the results obtained in the experiment it could be concluded that, among the 24 treatment combinations, seeds sown in the combination of growing medium containing soil + sand + vermicompost + cocopeat (2:1:1:1) inoculated with bio fertilizer Arka Microbial Consortium (M_3B_4) showed best results with regard to highest germination percentage at 30 DAS, number of leaves per seedling at 30 and 45 days after germination, stem girth (cm) at 30 and 45 days after germination, seedling height (cm) at 30 and 45 days after germination, chlorophyll content (SPAD units) at 45 days after germination, survival per cent of seedlings (%) at 45 days after germination.

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