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STANDARDIZATION OF SEED TREATMENT AND POTTING MIXTURE FOR PRODUCTION OF TOMATO SEEDLINGS IN PORTRAY NURSERY

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ABSTRACT
Studies were conducted with tomato cv.CO_3 on evaluation of seed and nursery management techniques for production of elite seedlings for transplanting. Studies on individual performance of seed fortification technique, seed coating technique, media and biocontrol agents and biofertilizers for portray nursery and their combination of the best revealed that seed designed as $ZnSO_4$ (1%) priming and coated with pink polymer (3%) along with pesticides *viz.*, bavistin @ 2g+ imidachloprid (1ml) and sown in portrays filled with mixture of vermicompost + coirpith (in equal volume) and added with pseudomonas + Azophos @ 10g per kg of seed produced elite seedlings which had 19% and 16.5% higher germination and biomass production.

KEYWORDS: seedlings, priming, pesticides, germination.

INTRODUCTION
Tomato (*Lycopersicon esculentum* Mill.) is widely grown vegetable crop in the world. The economics of this crop spreads throughout the world as it is widely used for fresh consumption and also processed for vegetable food industry. However, the productivity of tomato in India is very low (14.07 t ha-1) as compared to USA 73.87 t ha-. India's tomato productivity was lower than the world tomato productivity (27.47 t ha-1).One of the causes for lower productivity of tomato is identified as use of poor quality seed. Tomato, on the other hand is an annual crop, where the seeds are small with the 100 seed weight of 3g and are normally raised in the nursery and transplanted to the main field (Ilyas, 1994). Hence for production of quality seedling for main field transplanting adoption of seed treatment and nursery management techniques are warranted. In modern era, the seedling production has been developed as micro industry, where seedlings are raised in portrays and is directly transplanted to the main field, which necessitates the selection of media for root development and easy prickable nature in handling portrays for seedling production. Hence studies were made on identification of suitable seed treatment and enriched nursery media for portrays for production of quality seedlings. (Ilyas and Suartini, 1998) Yunitasari and Ilyas, (1994) also reported that seed treatment and selection of nursery media are important in management of tomato nursery.

MATERIALS & METHODS
Fresh seeds of tomato cv.CO3 with higher germination in line with certification standard were obtained from seed orchard of Tamil Nadu Agricultural University. The seeds were individually fortified with different inorganic nutrients / regulants *viz.*, GA_3 (100 and 200ppm), KNO_3 (1and 2%), KH_2PO_4 (1 and 2%) and $ZnSO_4$ (1and 2) in two different concentrations in two different durations using seed solution ratio of 1:1, for a duration of 8 and 16h. The seeds fortified were dried to original moisture content, and were evaluated for germination (ISTA, 2007), root and shoot length, dry matter production and vigour index (Abdul baki and Anderson, 1973). From the evaluated concentration of fortifying agents, seeds were fortified and film coated with pink polymer (3g/kg of seed) enriched with bavistin (2g/kg of seed) and imidachloprid (1ml per kg of seed) and evaluated for seed quality characters as expressed earlier. On the other hand, control seeds were germinated in different nursery media (vermi compost, coir pith, poultry manure, goat manure and FYM) and their combinations (Vermi compost +Coir pith, Vermi compost + Goat manure, Vermi compost + FYM, Vermi compost + Poultry manure, Coir pith + Goat manure, Coir pith + Poultry manure, Coir pith +FYM, Poultry manure + Goat manure, FYM+ Goat manure, FYM+ Poultry manure) in shade net condition. Based on germination and seedling growth characters the best media was selected (Vermicompost +Coir pith).Then the media along with normal nursery mixture (sand + soil + FYM in 1:1:1 ratio) was enriched with different combinations of biofertilizers and biocontrol agents (Azospirillum, Phospho Bacteria and Pseudomonas fluorescens) as additive inoculants @ 10g/kg of media and the best enriched combination of bio products was selected by germinating the control seeds. Then, the seeds fortified with GA_3 (200 ppm), KNO_3 (1%), KH_2PO_4 (1%) and $ZnSO_4$ (1%) were coated with polymer enriched with pesticides and were sown in the portrays filled with selected media that was enriched with bio regulants. The seeds were allowed to grow up in the nursery for a period of 21days and were evaluated for seed germination, seedling length and dry matter production. The data were analyzed as per panse and sukhathme (1997).

RESULTS & DISCUSSION

Influence of seed fortification treatment on seed quality characters

Highly significant results were obtained with the evaluated parameters (germination, root length, shoot length and vigour index) for the seed fortification treatments. The seeds fortified with with KNO_3 1% and $ZNSO_4$ 1% with 8h soaking duration recorded the highest germination percentage (96%) ,which was 165 higher than control (80%) . At 16h soaking duration, $ZNSO_4$ 1% recorded the highest value (94%), while GA_3 the lowest (84%) percentage.

Irrespective of soaking duration the seeds soaked in $ZNSO_4$ 1%, followed by KH_2PO_4 1% recorded higher seedling quality characters, while the shortest (12.64 cm) was with seeds fortified with GA_3 1%. $ZNSO_4$ 1% seed fortification also recorded significantly higher dry matter production while it was the lowest in control. Computed vigour index values were also higher with $ZNSO_4$ 1% seed fortification (Table1).

TABLE 1. Influence of seed priming on seed germination percentage, root length, shoot length, dry matter production and vigour index

Treatment	Germination %		Root length (cm)		Shoot length(cm)		Dry Matter Production10 seedling $^{-1}$ (g)		Vigour index	
	Soaking duration in hours with equal volume of seed to solution ratio									
	8h	12h	8h	12h	8h	12h	8h	12h	8h	12h
Control	80 (63.44)	80 (63.44)	12.43	12.51	5.25	5.16	0.0104	0.0102	1414	1412
GA_3 100ppm	84 (66.42)	86 (68.03)	12.84	12.64	6.23	5.93	0.0113	0.0106	1677	1597
GA3 200ppm	90 (71.57)	86 (68.03)	13.41	13.28	6.42	6.17	0.0117	0.0109	1784	1672
KNO3 1%	84 (66.42)	84 (66.42)	13.57	13.35	6.65	6.25	0.0122	0.0117	1981	1842
KNO3 2%	84 (66.42)	88 (69.73)	12.95	12.76	6.52	6.07	0.0119	0.0111	1830	1657
KH2PO4 1%	84 (66.42)	90 (71.57)	13.62	13.47	6.78	6.34	0.0124	0.0121	1917	1782
KH2PO4 2%	88 (69.73)	84 (66.42)	13.23	13.14	6.62	6.12	0.0120	0.0119	1786	1617
ZNSO4 1%	90 (71.57)	90 (71.57)	13.94	13.62	7.93	6.49	0.0135	0.0126	2100	1850
ZNSO4 2%	88 (69.73)	88 (69.73)	13.44	13.31	7.21	6.22	0.0132	0.0121	1941	1758
Mean	86 (68.03)	85 (67.22)	13.27	13.12	6.62	6.08	0.0121	0.0115	1826	1687
SEd	2.867	5.375	0.106	0.111	0.193	0.212	0.007	0.008	65.669	108.757
CD	6.612	12.395	0.244	0.263	0.451	0.489	0.0016	0.0018	151.432	250.796

Influence of seed priming cum enriched polymer coating on seed quality characters.

Seeds designed with fortification and coating treatment, revealed that seed treated with $ZNSO_4$ 1% + Carbendazim + Imidachloprid+ polycoat (93%)followed by KH_2PO_4 1% + Carbendazim + Imidachloprid + Polycoat (90.67 %) and the minimum (82.67%) was by control seeds. Among the treatments maximum seedling characters and vigour index values were (2137) recorded for seed treated with $ZNSO_4$ 1% + Carbendazim + Imidachloprid + polycoat followed by KH_2PO_4 1% + Carbendazim + Imidachloprid + Polycoat (2027) and the minimum (1634) was with control (Table 2).

TABLE 2. Influence of seed fortification and polymer coating on seed quality

Treatment	Germination %	Root length (cm)	Shoot length (cm)	Dry Matter Production 10 seedling $^{-1}$ (g)	Vigour index
Control + Carbendazim + Imidachloprid + Polycoat	83 (65.65)	12.91	5.85	0.0102	1634
GA_3 200ppm Carbendazim + Imidachloprid + Polycoat	85 (67.22)	13.38	6.72	0.0114	1801
$KNO_3$1%+ Carbendazim + Imidachloprid + Polycoat	87 (68.87)	13.97	7.12	0.0121	1901
KH_2PO_4 1% + Carbendazim + Imidachloprid + Polycoat	91 (72.55)	13.92	7.44	0.0127	2027
$ZNSO_4$ 1% + Carbendazim + Imidachloprid + Polycoat	93 (74.66)	14.13	7.76	0.0134	2137
Mean	88 (69.73)	13.66	6.98	0.0120	1900
SEd	2.066	0.202	0.124	0.0005	53.376
CD	4.763	0.466	0.286	0.0011	123.086

Influence of organic manures on seed quality characters

Among the manures and their combinations, the higher germination percentage (95.24%) was recorded with seed sown in Vermi compost +Coir pith and followed by Vermi compost + Poultry manure and Coir pith + Poultry manure (90.48%) and the minimum (71.90 %) was with FYM. Within the manures, longer root length (8.64 cm) was observed in Vermi compost +Coir pith and followed by Coir pith + Poultry manure (8.36 cm) and lowest root length (6.39 cm) with FYM. Among the treatments in manures, Vermi compost + Poultry manure recorded the maximum value for shoot length (7.66 cm), followed by Vermi compost +Coir pith (7.34 cm) The Vermi compost +Coir pith combination also recorded significantly higher dry matter production (0.0142 g) and the vigour index (1522) (Table 3).

TABLE 3. Influence of organic manures on seed quality characters

Treatment	Germination %	Root length (cm)	Shoot length (cm)	Dry Matter Production10 seedling $^{-1}$ (g)	Vigour index
Vermi compost	79 (62.73)	7.63	6.52	0.0104	1118
Vermi compost +Coir pith	84 (66.42)	8.64	7.34	0.0142	1342
Vermi compost + Goat manure	76 (60.67)	7.81	6.46	0.0112	1085
Vermi compost +fym	74 (59.35)	7.22	6.23	0.0095	995
Vermi compost + Poultry manure	82 (64.90)	8.23	7.66	0.0136	1303
Coir pith	76 (60.67)	7.57	6.34	0.0104	1057
Coir pith + Goat manure	80 (63.44)	7.41	6.53	0.0107	1115
Coir pith + Poultry manure	82 (64.90)	8.36	7.12	0.0129	1269
Coir pith +FYM	77 (61.35)	7.35	6.72	0.0096	1083
Poultry manure	81 (64.16)	7.92	6.43	0.0114	1162
Poultry manure + Goat manure	82 (64.90)	7.42	6.53	0.0102	1144
Goat manure	72 (58.05)	7.25	6.71	0.0103	1005
FYM	71 (57.42)	6.39	5.63	0.0094	853
FYM+ Goat manure	76 (60.67)	6.74	6.11	0.0101	977
FYM+ Poultry manure	79 (62.73)	6.53	5.84	0.0106	976
Mean	78 (62.01)	7.50	6.54	0.0110	1099
SEd	3.0214	0.315	0.289	0.008	42.346
CD	5.0131	0.427	0.376	0.0016	98.541

Influence of bio fertilizers and bio protectants on seed quality characters

The highest germination percentage (95.24 %) was recorded with V+ C media enriched with Azospirillum + Phosphobacteria followed *Pseudomonas fluorescens* + *Azospirillum* (90.48 %) and the minimum (82.67%) was with Soil +Sand +FYM mixture. Media enriched with Pseudomonas fluorescens + Azospirillum also recorded the higher root length was followed by Azospirillum + Phospho Bacteria and the Pseudomonas fluorescens + Azospirillum and minimum was with Phospho Bacteria applied as individual addition (Table 4).

TABLE 4. Influence of bio fertilizers and bio protectends on seed quality characters

Treatment	Germination %	Root length (cm)	Shoot length (cm)	Dry Matter Production10 seedling $^{-1}$ (g)	Vigour index
Soil+Sand+FYM					
Pseudomonas fluorescens	79 (62.73)	7.11	5.74	0.0104	1011
Azospirillum	81 (64.16)	7.32	5.91	0.0107	1069
Phospho Bacteria	76 (60.67)	6.44	6.14	0.0103	950
Pseudomonas fluorescens + Azospirillum	84 (66.42)	7.83	6.82	0.0112	1226
Pseudomonas fluorescens + Phospho Bacteria	81 (64.16)	6.61	6.13	0.0109	1029
Azospirillum + Phospho Bacteria	90 (71.57)	7.71	6.88	0.0114	1314
Mean	82 (64.90)	7.15	6.25	0.0108	1100
SEd	2.514	0.337	0.311	0.006	55.261
CD	3.286	0.471	0.532	0.009	108.105

Treatment	Germination %	Root length (cm)	Shoot length(cm)	Dry Matter Production10 seedling $^{-1}$ (g)	Vigour index
Vermicompost+ coirpith					
Pseudomonas fluorescens	86 (68.03)	7.31	6.21	0.0115	1153
Azospirillum	86 (68.03)	7.71	6.32	0.0114	1203
Phospho Bacteria	78 (62.01)	6.86	6.44	0.0109	1047
Pseudomonas fluorescens + Azospirillum	90 (71.57)	8.37	7.41	0.0121	1427
Pseudomonas fluorescens + Phospho Bacteria	87 (68.8)	7.22	6.23	0.0117	1084
Azospirillum + Phospho Bacteria	92 (73.57)	7.81	7.42	0.0124	1445
Mean	87 (68.8)	7.55	6.65	0.0117	1227
SEd	2.822	0.454	0.416	0.009	57.251
CD	3.471	0.536	0.502	0.017	112.349

5. Synergistic effect of seed and nursery management techniques on emergence and seed quality characters.

The results on synergistic effect of seed and nursery management techniques revealed that seeds designed with fortification and coating treatment, revealed that seed treated with $ZNSO_4$ 1% + Carbendazim + Imidachloprid + polycoat (93%) was sown in vermicompost and coirpith media enriched with Azospirillum + *Phosphobacteria* recorded the higher emergence(98%),speed of emergence and seedling quality characters.

TABLE 6. Synergistic effect of seed and nursery management techniques on emergence and seedling quality characters

Germination (%)

Seed Treatments	Soil+Sand+FYM			Manures			
	Azospirillum+ Pseudomonas fluorescens	Azospirillum+ Phosphobacteria	Azophos+ Pseudomonas fluorescens	Azospirillum+ Pseudomonas fluorescens	Azospirillum+ Phosphobacteria		Azophos+ Pseudomonas fluorescens
Control	78 (62.01)	80 (63.44)	83 (65.65)	81 (64.16)	83 (65.65)		85 (67.22)
GA_3	83 (65.65)	87 (68.87)	89 (70.63)	88 (69.73)	90 (71.57)		92 (73.57)
KH_2PO_4	87 (68.87)	90 (71.57)	93 (74.66)	89 (70.63)	92 (73.57)		96 (78.47)
$ZNSO_4$	88 (69.73)	89 (70.63)	95 (77.08)	91 (72.55)	93 (74.66)		98 (81.25)
Mean	84 (66.42)	87 (68.87)	90 (71.57)	87 (68.87)	90 (71.57)		93 (74.66)
	T	M	B	MxT	TxB	MxB	MxTxB
SEd	0.243	0.197	0.413	0.422	0.843	0.684	1.412
CD	0.427	0.312	0.781	0.817	1.728	1.251	N.S.

Root length (cm)

Treatments	Soil+Sand+FYM			Manures			
	Azospirillum+ Pseudomonas fluorescens	Azospirillum+ Phosphobacteria	Azophos+ Pseudomonas fluorescens	Azospirillum+ Pseudomonas fluorescens	Azospirillum+ Phosphobacteria		Azophos+ Pseudomonas fluorescens
Control	10.36	10.82	11.23	11.14	11.54		11.87
GA_3	12.86	13.14	13.34	13.22	13.48		13.61
KH_2PO_4	13.62	13.85	14.11	13.72	14.03		14.21
$ZNSO_4$	13.93	14.11	14.43	14.24	14.52		14.77
Mean	12.69	12.98	13.28	13.08	13.39		13.62
	T	M	B	MxT	TxB	MxB	MxTxB
SEd	0.019	0.014	0.037	0.041	0.089	0.062	0.143
CD	0.043	0.036	0.076	0.087	0.154	0.116	N.S.

Shoot length (cm)

Treatments	Soil+Sand+FYM			Manures			
	Azospirillum+ Pseudomonas fluorescens	Azospirillum+ Phosphobacteria	Azophos+ Pseudomonas fluorescens	Azospirillum+ Pseudomonas fluorescens	Azospirillum+ Phosphobacteria		Azophos+ Pseudomonas fluorescens
Control	8.71	9.41	10.05	9.91	10.22		10.48
GA_3	10.87	11.17	11.35	11.26	11.52		11.65
KH_2PO_4	11.44	11.68	11.85	11.78	11.94		12.06
$ZNSO_4$	11.62	11.75	12.02	11.87	12.21		12.46
Mean	10.66	11.00	11.32	11.21	11.47		11.66
	T	M	B	MxT	TxB	MxB	MxTxB
SEd	0.421	0.343	0.687	0.815	1.524	1.168	2.641
CD	0.943	0.711	1.326	1.501	2.964	2.112	N.S.

Dry matter production g per 10 seedlings

Treatments	Soil+Sand+FYM			Manures			
	Azospirillum+ Pseudomonas fluorescens	Azospirillum+ Phosphobacteria	Azophos+ Pseudomonas fluorescens	Azospirillum+ Pseudomonas fluorescens	Azospirillum+ Phosphobacteria		Azophos+ Pseudomonas fluorescens
Control	0.0116	0.0124	0.0132	0.0121	0.0129		0.0138
GA_3	0.0122	0.0129	0.0135	0.0125	0.0136		0.0147
KH_2PO_4	0.0126	0.0137	0.0143	0.0128	0.0147		0.0151
$ZNSO_4$	0.0131	0.0145	0.0152	0.0137	0.0156		0.0169
Mean	0.0124	0.0134	0.0141	0.0128	0.0142		0.0151
	T	M	B	MxT	TxB	MxB	MxTxB
SEd	0.006	0.003	0.006	0.009	0.008	0.007	0.0011
CD	0.0017	0.005	0.007	0.0021	0.0011	0.0012	N.S

Vigour index

Treatments	Soil+Sand+FYM			Manures			
	Azospirillum+ Pseudomonas fluorescens	Azospirillum+ Phosphobacteria	Azophos+ Pseudomonas fluorescens	Azospirillum+ Pseudomonas fluorescens	Azospirillum+ Phosphobacteria		Azophos+ Pseudomonas fluorescens
Control	1479	1610	1759	1697	1799		1893
GA_3	1961	2109	2192	2148	2245		2320
KH_2PO_4	2174	2292	2411	2264	2385		2520
$ZNSO_4$	2242	2296	2510	2371	2482		2667
Mean	1964	2077	2218	2120	2228		2350
	T	M	B	MxT	TxB	MxB	MxTxB
SEd	5.210	2.341	8.114	9.435	17.422	12.426	31.523
CD	11.445	8.231	16.542	21.526	34.522	26.422	N.S.

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