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Influence of Presowing Seed Treatment with Inorganic Nutrients on Seed and Seedling Quality Characters of Petunia Cv. Mix

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A B S T R A C T

Studies on evaluation of the influence of seed fortification with inorganic nutrients as pre-sowing seed management technique expressed that KH_2PO_4 and KCl at 1 per cent among the nutrients ($MgSO_4$, $MnSO_4$, $ZnSO_4$, $FeSO_4$, borax) were highly suitable for invigourating the seed and seedling quality characters. The seeds were fortified in the respective solution for a duration of 16 h with equal volume of seed to solution ratio. The fortified seeds also performed better at primary and secondary nursery conditions in production of elite seedlings for transplanting to main field.

Introduction

Rapid and uniform field emergences are the two essential pre requisite to increase the yield, quality and ultimately the profits in annual crops (Parera and Cantliffe, 1994).

Pre-sowing invigouration is one such technological highlight focused to the above goals. Pre-sowing seed invigouration treatments are numbered many by the researchers (Sundaralingam *et al.,* 2001) and all are claimed to have invigourative effect at field for enhancing the yield of crop to a tune of 10-15 per cent (Vijayakumar *et al.,* 1988). Seed fortification with inorganic nutrients is one such seed treatment for invigourating the seed before sowing. Nutrients are the other alternatives to growth regulators as they are cost effective and the lethality rate will be lesser at supra optimal levels. In addition they are also easily available than the growth regulator.

Adoption of any presowing technique for a particular crop required standardisation work as the response of the seed to the pre-sowing treatment varies with chemical, concentration and duration of the treatment. Hence the present study was formulated to standardize the seed fortification treatment with micro and macro nutrients for enhancing the production of elite seedling at primary and secondary nursery of petunia cv. Mix.

Materials and Methods

The fresh seeds of petunia cv. Mix obtained from M/s Namdhari seeds were soaked in equal volume of nutrient solutions viz., Magnesium sulphate ($MgSO_4$), Manganese sulphate ($MnSO_4$), Ferrous sulphate ($FeSO_4$), Zinc sulphate ($ZnSO_4$), Borax, Potassium chloride (KCl) and Potassium dihydrogen phosphate (KH_2PO_4) in two different concentration *viz.,* 0.5 and 1% for a duration of 8 and 16 h along with water. The seeds were shade dried for one day and were evaluated for the seed and seedling quality parameters *viz.*, germination (%) (ISTA, 1999), Speed of emergence (Maguire,1962), root and shoot length (cm), dry matter production 20 seedlings (mg) and vigour index (Abdul Baki and Anderson, 1973) after 10 days of sowing.

The germination test was conducted in germination room maintained at 25°C and 95 ± 2 % RH adopting the top of paper method. Based on the results the responsive duration of fortification irrespective of micro and macro nutrients was selected and the seeds fortified for 16 h in the above mentioned chemicals were evaluated at nursery, which consist of both primary and secondary nursery owing to the smallest and lightest nature of the seed.

The primary nursery was raised with earthern pots, while the secondary nursery was with pluck trays (8.5 cm dia). At nursery, after 15 days in primary and after 25 days in secondary, the seed and seedling quality characters *viz.,* emergence at primary nursery (%), establishment at secondary nursery (%), root and shoot length at secondary nursery (cm), fresh weight seedling^{-1} (g) and dry weight seedling^{-1} (g) were analysed. The data gathered were analysed statistically adopting the procedure described by Gomez and Gomez (1984).

Results and Discussion

In the present study highly significant difference were obtained due to nutrients and soaking duration for the seed quality characters *viz.,* germination (%) and speed of emergence, while significant difference was observed only due to nutrients for drymatter production (mg 20 seedlings^{-1}). However root length (cm), shoot length (cm) and vigour index observed a non-significant influence due to both nutrients and soaking duration (Table 1).

The results revealed that seed treatment with KH_2PO_4 and KCl at 1.0 per cent invigourated the seed better than others by recording 20 and 24 per cent higher germination than water soaking and control respectively. The invigourative response expressed by the other nutrients were in the order of $MgSO_4$ (0.5 and 1 per cent), $ZnSO_4$ (0.5 per cent), KH_2PO_4 (0.5 per cent), $MnSO_4$ (0.5 per cent), $FeSO_4$ (0.5 per cent), borax (1.0 per cent), KCl (0.5 per cent) and $ZnSO_4$ (1.0 per cent) while the least was observed with $FeSO_4$ (1.0 per cent) compared to both water soaking and control.

Not only the germination but also the seed quality characters evaluated in terms of seedling vigour characters and computed vigour index values were higher in the seeds fortified with KH_2PO_4 and KCl and the efficacy of other nutrients were in order, as that of germination. Between the durations, 16 h was found to be effective than 8 h. The better performance of KH_2PO_4 and KCl might be due to influence of K that had impregnated into the seed through seed coat and had promoted quicker germination, early growth with better stamina (Srivastava and Singh, 1973) and these early vigour might had been useful for the increased energy production and these stored food resources were utilised for growth (Wellingford, 1980).

Table.1 Influence of fortification treatment with inorganic nutrients on seed and seedling quality characteristics at nursery

Nutrients (N)	Emergence at primary nursery (%)	Establishment at secondary nursery (%)	Root length (cm)	Shoot length (cm)	Fresh weight seedling^{-1} (g)	Dry weight seedling (g)
$MgSO_4$ 0.5%	98 (82.05)	99 (86.03)	15.6	21.5	5.2	3.0
1.0%	98 (83.30)	99 (86.03)	15.4	21.8	5.4	3.2
$MnSO_4$ 0.5%	90 (71.95)	99 (86.03)	15.2	21.2	5.1	2.9
1.0%	94 (76.13)	99 (86.03)	15.4	21.4	5.3	3.2
$FeSo_4$ 0.5%	58 (49.61)	85 67.28)	13.3	16.5	4.3	2.8
1.0%	55 (47.91)	80 63.93)	13.0	16.0	4.1	2.6
$ZnSO_4$ 0.5%	95 (77.50)	99 (86.03)	15.6	21.5	5.2	3.2
1.0%	98 (83.30)	99 (86.03)	15.2	21.7	5.3	3.4
Borax 0.5%	79 (62.76)	88 (70.15)	14.3	17.0	4.3	3.0
1.0%	68 (55.66)	80 (63.55)	14.0	16.8	4.6	2.7
KCl 0.5%	92 (73.76)	95 (77.50)	15.4	21.2	5.2	3.2
1.0%	97 (81.80)	98 (83.30)	15.3	21.5	5.4	3.3
KH_2PO4 0.5%	95 (77.12)	99 (86.03)	15.7	21.7	5.3	3.2
1.0%	98 (83.30)	99 (86.03)	15.8	22.0	5.6	3.5
Water soaking	60 (50.80)	80 (63.55)	13.8	16.8	4.0	1.8
Mean	**85 (70.46)**	**93 (78.50)**	**14.9**	**19.9**	**5.0**	**3.0**
CD (P=0.05)	2.919	2.697	0.432	0.597	0.198	0.187

(Figures in parentheses indicate arc sine values)

Table.2 Influence of fortification treatment with inorganic nutrients on seed and seedling quality characteristics at germination room

Nutrients (N)	Germination (%)			Speed of emergence			Root length (cm)			Shoot length (cm)			Dry matter production (mg 20 seedlings^{-1})			Vigour index		
	Duration in hours (D)																	
	8	16	**Mean**	8	16	**Mean**	8	16	**Mean**	8	16	**Mean**	8	16	**Mean**	8	16	**Mean**
$MgSO_4$ 0.5%	89 (70.64)	92 (73.59)	**91 (72.11)**	8.6	8.7	**8.7**	0.7	0.5	**0.6**	1.7	1.6	**1.7**	1.8	2.0	**1.9**	214	194	**204**
1.0%	90 (71.80)	92 (73.65)	**91 (72.73)**	8.6	8.8	**8.7**	0.4	0.5	**0.5**	1.6	1.7	**1.7**	1.9	2.1	**2.0**	181	203	**192**
$MnSO_4$ 0.5%	84 (66.48)	90 (71.69)	**87 (69.09)**	8.4	8.6	**8.5**	0.4	0.5	**0.5**	1.6	1.7	**1.7**	1.7	1.8	**1.8**	169	199	**183**
1.0%	83 (65.92)	94 (76.13)	**89 (71.02)**	8.3	8.8	**8.5**	0.5	0.5	**0.5**	1.7	1.6	**1.7**	1.7	1.9	**1.8**	183	198	**192**
$FeSO_4$ 0.5%	87 (68.95)	84 (66.43)	**86 (67.69)**	8.4	8.3	**8.3**	0.4	0.5	**0.5**	1.6	1.4	**1.5**	1.6	1.5	**1.6**	171	160	**166**
1.0%	84 (66.53)	72 (58.06)	**78 (62.29)**	8.2	7.8	**8.0**	0.5	0.6	**0.5**	1.5	1.3	**1.4**	1.7	1.4	**1.6**	169	138	**153**
$ZnSO_4$ 0.5%	88 (69.77)	92 (73.65)	**90 (71.71)**	8.5	8.6	**8.6**	0.7	0.6	**0.7**	1.7	1.7	**1.7**	1.7	1.9	**1.8**	212	212	**212**
1.0%	80 (63.47)	88 (69.77)	**84 (66.62)**	8.4	8.6	**8.5**	0.5	0.5	**0.5**	1.8	1.7	**1.8**	1.8	2.0	**1.9**	168	194	**182**
Borax 0.5%	86 (68.03)	89 (70.74)	**88 (69.39)**	8.3	8.4	**8.4**	0.6	0.6	**0.6**	1.6	1.5	**1.6**	1.5	1.6	**1.6**	190	178	**184**
1.0%	88 (69.77)	84 (66.43)	**86 (68.10)**	8.5	8.3	**8.4**	0.5	0.5	**0.5**	1.6	1.6	**1.6**	1.5	1.4	**1.5**	186	177	**181**
KCl 0.5%	86 (68.16)	84 (66.53)	**85 (67.34)**	8.3	8.2	**8.3**	0.5	0.6	**0.6**	1.7	1.7	**1.7**	1.8	1.7	**1.8**	190	194	**192**
1.0%	96 (78.72)	95 (77.96)	**96 (78.34)**	9.5	9.5	**9.5**	0.6	0.7	**0.7**	1.9	1.8	**1.9**	1.9	1.8	**1.9**	234	239	**237**
KH_2PO_4	85	92	**89**	8.5	9.0	**8.7**	0.5	0.6	**0.6**	1.7	1.8	**1.8**	1.9	2.1	**2.0**	187	222	**205**

0.5%	(67.28)	(73.65)	**(70.46)**															
1.0%	96 (78.52)	96 (79.12)	**96 (78.82)**	9.8	9.8	**9.8**	0.6	0.5	**0.6**	1.8	1.7	**1.8**	2.0	2.0	**2.0**	231	212	**221**
Water soaking	74 (59.38)	78 (62.04)	**76 (60.71)**	8.0	8.1	**8.0**	0.6	0.6	**0.6**	1.4	1.6	**1.5**	1.4	1.5	**1.5**	148	174	**161**
Mean	**86 (68.89)**	**88 (70.63)**	**87 (69.76)**	**8.5**	**8.6**	**8.6**	**0.5**	**0.6**	**0.5**	**1.7**	**1.6**	**1.6**	**1.7**	**1.8**	**1.8**	189	193	**191**
CD (P=0.05)	N	D	ND	N	D	ND	N	D	ND	N	D	ND	N	D	ND	N	D	ND
	3.036	1.108	4.293	0.079	0.029	0.112	NS	NS	NS	NS	NS	NS	0.295	NS	NS	NS	NS	NS

(Figures in parentheses indicate arc sine values)

In addition, in KH_2PO_4 the presence of P could have act as an energy carrier in biochemical reaction with K including the N uptake in plant metabolism (Beringer, 1978). Kursnanov *et al.*,(1965) and Okanenko and Bershtein (1996) reported that K improved the oxidative phosphorylation, utilization of sugar along with pentose phosphate cycle, synthesis of mitochondria and the activity of ATPase and other enzymes and these could have improved the germination capacity of seeds. Similar increase in germination by pre-sowing seed treatment with KH_2PO_4 was also reported by Mehrotra *et al.,* (1968) in wheat and Vijayakumar *et al.,* (1988) in bhendi. The increase in germination by KCl treatment might also be due to the action of K and Cl which acted as agents during the hydration of the seed and maintained a state of swelling which is congential for the development of plasma colloids which helps in seedling development. (Kamfer and Zehlar, 1967). The results of the present findings also could be due to the above reasons and was supported by Punithavathi (1997) and Kalarani *et al.,* (2001) in ragi. On the other hand, the deleterious effect of higher concentrations might be due to their toxic effect on physiological and biochemical processes within the cell (Swartz,1941). However seed fortification with $FeSO_4$ (1 per cent) was found to deleterious for seed germination.

The evaluations of the fortified seeds at nursery also expressed that the nursery emergence and establishment of seeds at primary and secondary nurseries exposed similar sequential order of performance as that of germination (Table 2) highlighting the efficacy of KH_2PO_4 for seed fortification that had extended up to the nursery period in production of elite seedling for better establishment at main field. Subrhamanyan and Misra (1980) also reported that seed treatment with KH_2PO_4 as a compound resulted in maintenance of higher water balance in the tissue and enhanced the photosynthetic activity, and ultimately contributed to increase in establishment. Thus the study revealed that

Seed fortification with KH_2PO_4 and KCl (1 per cent) improved the emergence and seedling establishment at primary and secondary nursery.

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