

EFFECT OF PRE-SOWING SEED TREATMENT ON YIELD ATTRIBUTING CHARACTERS AND SEED YIELD IN FLOWER CROPS

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INTRODUCTION

Management techniques are warranted in any production practices. Pre-sowing seed management practices have drawn the attention of the scientist from time immemorial for boosting the potentiality of the seed at store and field including nursery. Rapid and uniform field emergence is the two essential pre requisite to increase the yield, quality and ultimately the profits in annual crops (Parera and Cantliffe, 1994). Pre-sowing invigoration is one such technological highlight focused to the above goals. Pre-sowing seed invigoration treatments are numbered many by the researchers (Sundaralingam *et al.*, 2001) and all are claimed to have invigorative effect at field for enhancing the yield of crop to a tune of 10-15 per cent (Vijayakumar *et al.*, 1988).

Some of the widely pronounced pre-sowing seed management techniques are seed fortification with growth regulators (Chandola *et al.*, 1973), nutrients (Venkataraman *et al.*, 1978), botanicals (Jegathambal, 1996), pelleting (Balaji, 1990), osmotic priming (Adegbuyi *et al.*, 1981) seed infusion (Khan and Tao, 1977), stress management against alkaline condition (Blum, 1987) and pollutants (Agarwal and Hemalata, 1992). Adoption of any of this technique for a particular crop required standardization work as the response of the seed to the pre-sowing treatment varies with chemical, concentration and duration of the treatment. Standardization is even stressed based on the lot, as ageing is one another factor that modifies or alters the response of seed to any physical or physiological management technique (Sundaralingam *et al.*, 2001).

Invigoration effect could be imposed into the seed by application of bioactive chemicals for improving the endogenous level of the substance, which in turn can improve the vigor of seed. These pretreatment with bioactive chemicals improves not only germination but also for the yield of economic part the flower and the seed in several instants. Austin *et al.* (1973), Chellapa and Karivaratharaju (1973), Padmajarao (1979), Jhorar *et al.* (1982), Seenu (1987), Begum *et al.* (1997) with their studies with different crop emphasized that pre-sowing fortification treatment with growth regulators such as GA₃, IAA and IBA were warranted as they enhanced the germination both at field and laboratory and the seedling emergence and establishment at field.

Jerlin *et al.*, (1997) also reported that growth and development of a plant are under the control of various growth regulating substances and external application of a particular growth regulator could cause promotion or inhibition of growth depending upon the concentration of the applied solution (hormone or growth regulator) and many growth regulating substances had been tried to boost up the growth of various crops with varying degree of success (Hatano and Asakawa, 1964).

The pre-sowing seed treatment recommended for invigorating the various flower seeds are tabulated as follows:

Table-1

Common Name	Treatment	Effect	Authority
Seed Crop			
Pansy	Soaking in GA ₃ 100 ppm for 24 h	Increased the number of seed, fruit, weight of seeds/fruit (31.59 mg) and weight of seed (1.21 g)	Bose and Kapur (1969)
	Seed soaking in GA ₃ @ 100-200 mg/lit	Produced excellent germination	Renard and Clera (1978)
	Seed priming with PEG – 1.0 MPa for 7 days at 35°C	Improved the germination to 51% than control (10%)	William (1991)
Marigold <i>Tagetes erecta</i>	GA ₃ soaking for 30 min at 25 ppm	Greatest improvement in germination per cent, stem height, flower number, size and weight	Sharga <i>et al.</i> (1970)
	Seed soaking in 0.75% KNO ₃	Improved the germination (89.5%) and vigour potential	Selvaraju and Selvaraj (1994)

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		Improved the germination	Djewas and Staden (1990)
	Soaking seeds in 10,000 mg/lit of humic acid	Improved the root and shoot fresh weight and germination	Hart Wigsen and Evans (2000)
<i>Primula vulgaris</i>	Chilling at 2.°C for 4 weeks	Improved the germination per cent	Thompson (1970)
	Seeds are kept at 15 to 25°C and soaked in 0.25% KNO ₃ Plus light	Improved the germination and the seedlings are vigorous	Chavagnat (1981)
<i>Primula vulgaris</i>	Seed soaking in 250 ppm GA ₃ for 24 h	Increased the germination to 88 per cent compared to control (55%)	Miller and Holcomb (1982)
	Seed soaking in GA ₄₊₇ @ 10 ⁻⁴ m + BA (10 ⁻⁵ m)	Improved the germination	Finchsavage <i>et al.</i> (1991)
Geranium	Dehulled seeds with conc. H ₂ SO ₄ for 5-8 minutes	Overcome the hard seeds	Heit (1971)
China aster	Seed inoculation with 1:1 mixture of phosphobacteria	Advanced the plant development and increased the seed yield	Vorobeva (1977)
Rose	Presowing seed treatment with vitamin B2	Increase the germination by 51 per cent	Serebryakava and Kalanova (1977)
Balsam <i>Balsam verbena</i>	Seeds washed in running water for ½ hour and then soaked in 5 ppm IBA for 20 h	Increased the number of buds (30) and number of flowers	Agnihorti <i>et al.</i> (1964)
	Seed soaking in GA ₃ @ 100-200 mg/lit	Produced excellent germination	Renard and Clera (1978)
	Dry seed soaked for 24 h in saturated solution of diethyl sulphate	Decrease the plant height, number of branches, flowers and fruits per plant than control	Bose and Basu (1967)
	Seed soaking in water, IBA, IAA, GA, ascorbic acid and kinetin solution @ 100, 1, 10 µg/ml	100 per cent germination in water, 1 µg/ml of GA ₃ and IAA treatment after 48 hours	Aeri and Tiagi (1969)
	Soaking in GA 500 ppm	Enhanced the uniformity of germination	Jouret (1977)
	Dry seeds infused with 10 mm GA ₃	Gave higher germination	Persson (1993)
Lavandula	Seed soaking in GA ₃ @ 100-200 mg/lit	Produced excellent germination	Renard and Clera (1978)
<i>Sterlitzia reginae</i>	Seed soaking in thiourea @ 500 ppm or Ascorbic acid 1000 ppm or ethrel 2000 ppm or incubation in oxygen at 100% and chipping the seeds in the proximal region	Improved the germination	Venter (1978)
Chrysanthemum	GA ₃ soaking for 24 h at concentration of 20, 40, 60 and 80 ppm	Improved the germination to 56 – 64 per cent	Barkar (1980)
	Seed soaking in thio urea 0.5 per cent and KNO ₃ 0.2 per cent	Increased the germination to 31 per cent and 14 per cent thiourea and KNO ₃ respectively	Guang Dong <i>et al.</i> (2000)
	Seed soaking in 1 per cent KOH for 30 minutes followed by washing for 6 h	Promoted the germination	Chiang Maehee and Park Kuenwoo (1997)
Dianthus	Seed soaking in GA ₃ for 24 h at concentration of 20, 40, 60 and 80 ppm	Improved the germination to 72 – 96 per cent	Barkar (1980)
Gaillardia	Seed soaking in GA ₃ for 24 h at concentrations of 20, 40, 60 and 80 ppm	Improved the germination from 64 to 86 per cent	Barkar (1980)
	Seed soaking in GA ₃ 200 ppm for 16 h	Improved the germination to 87 per cent than control (71 per cent)	Vijayan (2002)
<i>Pharbitis nil</i>	Seed soaking in 100 per cent H ₂ SO ₄ for 40 minutes	Improved the germination to 98 per cent	Xu and Gu (1985)
<i>Calluna</i>	Seeds soaking in GA ₃ @ 250, 300	Germination was 100 per cent in	Grimstad (1986)

<i>vulgaris</i>	and 500 ppm for 24, 22 and 18 days	all the treatments	
<i>Cyclamen persicum</i>	Seed soaking in GA ₃ 5 ppm	Enhanced the germination but at higher concentration decreased the germination	Lee and Lee (1986)
	Soaking in GA ₃ at 1, 3 and 5 ppm	Gave 100 per cent germination compared to 80 per cent in control	Qrunfleti (1986)
<i>Petunia Petunia hybrida</i>	Seeds soaking in GA ₃ at 150 µg/ml for 15 days at 20°C	Improved the germination to 72 per cent	Gonzalez and Villa lobos (1988)
	Cold stratification for 15 days	Improved the normal seedlings of 73 per cent	Gonzalez and Villa lobos (1991)
	Seed soaking in GA 4/7	Increased the germination per cent and reduce the mean germinated time	Finch Savage (1991)
Scotch broom <i>Cytisus scoparius</i>	Sequential rapid immersion in hot water (10 minutes) followed by liquid nitrogen (15 minutes)	Improved the imbibition and germination by 3 fold	Abdallah <i>et al.</i> (1989)
<i>Zinnia Zinnia elegans</i>	Seed soaking in 100 mg GA ₃ or 100 mg GA _{4&7}	Increases the germination percentage compared to control	Grezesik (1989)
	Seed soaking in NAA (5-20 mg), GA ₃ (50-200 mg/lit) and GA _(4&7) – (50 – 200 mg lit)	Plants started to earlier flowering and were taller and better quality	Grezesik and Chojnowski (1992)
	Seed soaked in alcohol such as hexacosanol, octacosanol and triacontanol @ 0.001, 0.01 and 0.1 mg/lit	Lower concentration increased the seed germination and seedling growth was stimulated	Blamowski and Borowski (1995)
	Seed soaked in H ₂ O ₂	Promote the seed germination	Ogawa and Iwabushi (2001)
	Seed soaked in GA ₃ ppm for 16 hours	Increased the germination to 75 per cent than control (61 per cent)	Vijayan (2002)
<i>Matthiola incana</i>	Seed soaking in 10 mg GA ₃ or 100 mg GA _{4&7} /lit	Improved the germination	Grezesik (1989)
	Soaking seeds in GA ₃ (50 – 200 mg/lit) for 24 h	Improved the germination	Grezesik (1995)
<i>Paeonia lactiflora</i>	GA ₃ treatment	Increased the flower buds	Evans <i>et al.</i> (1990)
<i>Magnolia grandiflora</i>	Soaking seeds in GA ₃ 1000 ppm	Highest germination percentage (70) was obtained	Misiha and El Ashry (1991)
<i>Pantemon parryi</i>	Soaking in GA ₃ 500 ppm for 24 h	Enhanced the germination to 97 per cent	Raeber and Chiwon (1991)
Snap dragon	Soaking seeds in 100 – 150 µg/ml of GA ₃	Improved the germination to 85 - 90 per cent	Montero <i>et al.</i> (1992)
Coreopsis	Dry seeds infused with 10mm GA ₃	Gave higher germination per cent	Persson (1993)
Ornamental sp.	Wet seed dressing of Akrygel R.P.	Gave best germination per cent	Hetman <i>et al.</i> (1996)
Pelargonium	Soaking seeds in 10.000 mg/lit of humic acid	Improved the root and shoot fresh weight and germination per cent	Hartwigsen and Evans (2000)
Lewisia hybrid	Soaking in GA ₃ 100 mg/lit for 24 h	Increase the germination to more than 60 per cent	Ael brecht (1989)
Phlox	Soaking seeds in GA ₃ 100 ppm for 8 h	Increased the germination to 90 per cent than control (60 per cent)	Sathyanarayanan (2000)
Vegetative propagation			
<i>Ipomea fistulosa</i>	Root dibbing of IBA 100 mg/lit	Enhanced the growth	Anand <i>et al.</i> (1972)
Bogainvillae	Dibbing in 10 or 100 ppm IBA or NAA	Increased the root formation	Mukhopadhyaya and Bose (1966)

Tulip	Bulb treatment with BA at 0.25%, NAA 0.25 and 0.5% and GA 0.5 and 2.0% and kept at 20°C for 2 ½ months	GA ₃ and NAA had adverse effect and stimulate flower stalk but delayed flowering	Saniewski <i>et al.</i> (1975)
	Ethrel 1000 ppm for 24 h	Inhibited flower stalk development	Eldabh <i>et al.</i> (1981)
	Ethrel 100 ppm for 24 h	Delayed the flowering and increased the length and diameter of flower stalk	
	GA ₃ 1000 ppm for 24 h	Had no effect on flower stalk but increased the bulb fresh weight	
	Dipping in succinic acid @ 0.02 per cent for 30 min	Increased the yield to marketable daughter bulbs	Mugge (1988)
Begonia	GA ₃ treatment on stem cuttings	Inhibit the formation of aerial tubers and increased sprouting	Okagami <i>et al.</i> (1977)
	B9 – chlorphonion or CCC to cuttings	Delayed the onset of dormancy	
<i>Diffenbachia picta</i> cuttings	Dipping 40 mg/lit of kinetin or 25 mg/lit of IAA	Best root development	Elshafie and Heisel (1977)
Lilac	Cuttings are soaked in NAA @ 0.8%	Produced the highest per cent of rootings	Schmidt (1977)
Gladiolus	Soaking in ethrel 100 ppm	Increased the flower size and length of flower stalk	Roychoudhuri <i>et al.</i> (1985)
	Soaking in KNO ₃ 2000 ppm	Enhanced the sprouting	
	Soaking in kinetin 25 ppm	Increased the plant height, leaf number and corm weight	
	Soaking corms in kinetin 25 and 50 ppm for 6 h	Increased the number of florets/spike and flower size	Nilimesh (1989)
Gladiolus	Dipping in Emisan @ 0.2 per cent for 10 min	Controlled the root rot	Singh and Arora (2001)
Freesia	Corms are treated with 100 ppm GA ₃ at 12°C for 7 days	Advanced the flowering and increased the yield	Cocozzatalia (1985)
Achimenes	GA ₃ @ 50 mg/lit for 16 h and temperature treatment (21°C) for 22 weeks	Influenced the height, number of leaf whorls and flowers	Vlahos (1985)
<i>Zantedeschia elliptoriana</i>	GA ₃ 500 ppm for 10 min as preplant rhizome soak	Increased the number of flower shoots and flower per shoots	Cort and Widmer (1987)
Antirrhinum	Soaking in 100 mg GA ₃ or 100 mg/lit of GA ₄₊₇	Increased the germination	Grezesik (1989)
	Osmo conditioned with PEG and treated with GA ₃	Improved the germination	Kepezynski (1989)
Tuberose	Soaking the bulbs in GA ₃ @ 45 ppm for 24 h	Improved the germination percentage	Belorkar <i>et al.</i> (1993)
	Soaking in GA ₃ @ 200 ppm	Produced maximum number of spikes and highest number of florets per spike	Preetiharbarua <i>et al.</i> (1997)
	Bulb soaking in GA ₃ 500 and 1500 ppm for 24 h	Increased the flower spike length, rachis length, number of spikes per plant, and florets per spike	Nagaraja <i>et al.</i> (1999)
	Soaking the bulbs in GA ₃ 200 ppm	Increased the growth, flowering and bulb production	Tiwari and Singh (2002)
Foot ball lily	Soaking in GA ₃ 150 ppm	Earlier flowering (95.4 days) and longest flower duration (8.8 days) was obtained	Ashutoshmisha <i>et al.</i> (2000)
<i>Rosa corymbifera</i>	"Garetta" a commercial compost	Increased the germination to 95 per cent	Morpeth and Hall (2000)

Sources: Authors Compilation

The studies revealed that 34 different chemicals are being used for invigorating the flower seeds .Among them GA₃ occupies the wider role which has been claimed to be due to breakdown of starch and other substrates that induced the enzyme action, the first



step of the germination process which created an ability to overcome a metabolic block in the embryonic axis of endosperm (Chen and Chang, 1972). Chen and Park (1973) also demonstrated that low concentration of GA₃ could stimulate amylase production in the absence of germination. However, Jacobson and Zwar (1974) reported that GA₃ did not influence the synthesis of total RNA in aleurone tissue. However, Ho and Varner (1974) concluded that GA₃ promoted the synthesis of specific mRNA responsible for *in vitro* synthesis of amylase between 5-8 h of GA₃ treatment. Hence, this could be the reason for the enhanced germination obtained in the present study with GA₃ compared to other growth regulators. Taiz and Honigman (1976) also reported that GA₃ enhanced the activity of endo-1, 4-xylanase in the aleurone layer. The multiplicity of the effects of GA₃ in the regulation of enzyme synthesis and secretion in aleurone cells indicates that this hormone has the potential to regulate germination in numerous ways.

Wood and Paleg (1974) also demonstrated that GA₃ could modify the permeability towards glucose of modal membrane systems (liposomes) based on lecithin and that GA₃ could enter into chemical combination with phospholipids (Wood *et al.*, 1974) and thus increased the germination. When GA₃ was used at higher concentration it decreased the germination significantly due to the lethal activity stimulated on enzyme reaction at supra optimal condition as reported by Chawan and Choudhri (1967) in cotton. GA₃ which was attributed to the increase in cell division and proliferation to root and apical meristem tissues by Das *et al.* (1989) and Chhipa and Lal (1988). The enhanced seed germination by GA₃ fortification was also explained to be due to a stimulation of hydrolytic enzyme activity / synthesis known to be induced by gibberellic acid as reported by Jhorar *et al.* (1982). The better performance of IAA and IBA might be due to greater chemical stability and has low mobility in plants (Audus, 1959).

The promotion of germination in ascorbic acid is possibly due to its active participation in different metabolic reaction as an essential associate of a number of enzyme systems.

Sunyuzhen *et al.* (1996), and Gyweihong *et al.* (1997) also reported that soaking of seeds in KNO₃ responded well to this treatment and nitrate levels in the seed have been positively correlated with the level of seed germination. Addition of KNO₃ enhanced the seed germination healing the light and chilling requirement of seed (Copeland, 1988). The promotion of germination by nitrate treatment has been suggested due to conversion to nitrate within the seed (Hendricks and Taylorson, 1975). Nitrate has been proposed to induce germination by enhancing pentose phosphate pathway activity in the seed through inhibition of catalase and increased oxidation of NADPH₂ (Hendricks and Taylorson, 1975, and Roberts 1973). It is expressed that it is plausible to have enhanced germination due to KNO₃, which is the outcome of quantitative and qualitative shifts in protein synthesis induced by KNO₃. Dormancy sometimes imposed by paucity of oxygen caused by supraoptimal activity of the citric acid cycle, which utilizes all available nitrogen. Potassium nitrate has been reported to raise the ambient oxygen level by making less oxygen available for the citric acid cycle (Bewley and Black, 1982). KNO₃ was found to counteract light inhibition and promote the germination. KNO₃ is also found to interact with temperature for promotion of seed germination.

The better performance of KH₂PO₄ 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 use of the stored food resources for growth (Wellingford, 1980). In addition, in KH₂PO₄ 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). Kusnanov *et al.*, (1965) and Okaneneko 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.

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 congenial for the development of plasma colloids, which helps in seedling development. (Kamfer and Zehlar, 1967). Subramanyan and Misra (1980) reported that seed treatment with KH₂PO₄ 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.

Rao *et al.* (1976) reported that the NAA increased the source activity i.e. accumulation of reducing sugar at flowering and pod developmental stage which could supply required assimilates for pod development.

The increase in germination by compost might be due to porous nature, drains well, warms readily in the sun, allows easy penetration, easily removable for repotting, should contain lower level of nitrogen, and balanced levels of other nutrients (Richards *et al.*, 1964).

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