



Seed Priming and Media for Enhanced Seedling Growth in Pansy (*Viola tricolor*)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The alarming increase of temperature in Northern areas of India makes it difficult to grow seeds due to these temperature fluctuations. Since Punjab is the hub of annual flower seed production it becomes imperative to identify suitable seed priming and growing media for proper growth and germination of seedlings of annual flower crops. Hence this investigation was conducted in PAU, Ludhiana to evaluate different pre sowing seed treatment and growing media in pansy seeds for better growth and development of seedlings. The maximum shoot length (5.75cm), root length (5.38 cm), number of leaves per plant (8.00), fresh weight (14.04g), dry weight (1.42 g) and SPAD index (34.43) was recorded through synergistic effect of GA₃ @ 25 ppm + soil: cocopeat: vermicompost (1:1:1) in pansy. Therefore, it was concluded from the study that treatment combination of GA₃ @ 25 ppm + soil: cocopeat: vermicompost (1:1:1) was found to be the best for almost all parameters as compared to the other treatments.

Keywords: *Viola tricolor*; pansy; growing media; seed treatment; cocopeat; GA; thiourea; SPAD index.

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1. INTRODUCTION

Pansy (*Viola tricolor*) considered as most vibrant and commonly grown winter annual. It belongs to the family Violaceae and is native of cooler parts of Europe [1]. It is commonly called as 'the flower of all seasons' and is cultivated as bedded and pot plant [2]. The name "pansy" originated from French word "pensee" meaning "thought" and evolved to denote love thoughts. The flower is 5 to 8 cm in diameter and has two slightly overlapping upper petals, two side petals and a single bottom petal with a slight beard emanating from the flower's centre. A huge increase in the demand for pansy has been noticed in the recent years mainly in window boxes, gardens, pot plants, dye industry and for culinary purpose etc.

The most specific problems concerned with pansy cultivation is that the seeds are difficult to germinate and there is lack of suitable media. This problem produces unbalanced seedling growth and further affects the performance of plants in terms of growth, branching, less flower and seed yield [3]. There is a large difference between the seeds sown and availability of healthy seedlings as germination goes below 40% and available seedlings for planting are only 30-40% [4]. This causes monetary losses to the growers because of costly pansy seeds especially F_1 hybrids. Hence, there is an urgent need to use some techniques for improving production of healthy seedlings of pansy.

One such method of improving the seedling quality is giving pre-sowing controlled seed treatment (Priming) i.e. hydration followed by re-drying in controlled conditions. It improves seed germination percentage, rate, time and quality of seedlings especially under adverse conditions [5]. The nursery media also plays a significant role for seedling growth and affects the quality of seedlings [2]. Different rooting media such as vermicompost, cocopeat can be used to grow pansy seedlings while maintaining the chemical and physical properties of medium like pH, texture, structure as well as N, P, K are dominant factors for development and growth of plant [6]. The germination percentage can be maximized up to 80 to 85% by using the best technologies. This tool can be successfully used in annual flower seeds to eradicate the problem of poor seedling growth which will ensure larger benefits to the growers and consequently quality of seedlings will be better.

The use of seed treatment techniques and growing media compositions will be very economical for the seed companies in terms of high returns as a result of improved germination values and production of better seedlings. Thus, realizing the importance of pansy at commercial level, there is need to investigate the effect of seed priming and media to improve the seedling growth for production of healthy seedlings.

2. MATERIALS AND METHODS

The present investigation was carried out during the year 2020-21 at Research Farm of Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana, Punjab. The seeds were given pre sowing treatment for 24 hours with control/water (T_1), Thiourea @ 50 ppm (T_2), KNO_3 @ 0.1% (T_3), KNO_3 @ 0.2% (T_4), GA_3 @ 25 ppm (T_5), GA_3 @ 50 ppm (T_6) and GA_3 @ 75 ppm (T_7) and sown in plug trays in October as per different media compositions i.e. soil: FYM (1:1; M_1), soil: sand: vermicompost (1:1:1; M_2), soil: sand: FYM (1:1:1; M_3), soil: sand: leaf manure (1:1:1; M_4), soil: cocopeat: vermicompost (1:1:1; M_5) and soil: leaf manure (1:1; M_6). A total of 30 seeds per treatment per replication were sown out of which 5-10 healthy seedlings were taken for observations. The experiment was laid out in factorial CRD design with three replications per treatment. The data on various seedling growth parameters were recorded and analysed using SAS software and treatment means were compared using DMRT (Duncan Multiple Range Test) at 5% level of significance [7]. Chlorophyll content was measured by using SPAD index meter in the mid of a clear day. Random healthy seedlings were taken 45 DAS in pansy for measuring fresh weight and wrapped in the butter paper for drying in a microwave oven for 48 hours at 65°C. Then seedlings were removed and allowed to cool before weighing in an electronic balance. After weighing average was worked out and dry weight was calculated of seedlings. The nitrogen in media sample was measured by Kjeldahl's method [8]. Available phosphorus (mg/kg of media sample) was measured after shaking the media with extractant and filtering the suspension through Olsen method on spectrophotometer at wavelength of 760 μm [9]. Available potassium (mg/kg of media sample) was measured after digestion of mixture of media and filtering the suspension for recording value on the flame photometer at 420 μm [10]. The data was calculated by using formulas given below-

- 1. Moisture content (%):** The moisture content of seedlings was calculated by using following formula:

$$\text{Moisture content \%} = \frac{\text{Fresh weight} - \text{Dry weight}}{\text{Fresh weight}} \times 100$$

- 2. Dry matter (%):** Dry matter percentage was calculated by subtracting the moisture content from 100%.

$$\text{Dry matter \%} = 100\% - \text{Moisture content}$$

3. RESULTS AND DISCUSSION

The effect of pre-sowing seed treatment and media on seedling growth parameters of pansy i.e. shoot length, number of leaves per seedling, SPAD index, root length, root: shoot ratio, fresh weight of seedlings, dry weight of seedlings, moisture content percentage and dry matter percentage was recorded to be significant ($p < 0.05$) (Table 1 and 2).

Among pre sowing seed treatments, the seeds of pansy treated with GA₃ @ 25 ppm recorded maximum shoot length (5.00cm), number of leaves (7.28), SPAD index (33.08), root length (4.79 cm), fresh weight (12.94g) and dry weight (1.31 g). The highest dry matter percentage was recorded in KNO₃ @ 0.2% (10.41%) and found to be significantly different from other treatments. In case of moisture content percentage was significantly recorded in Thiourea @ 50 ppm (90.05%) followed by GA₃ @ 25 ppm (89.87%) which were at par.

Among media treatments minimum shoot length (5.04cm), number of leaves (7.24), SPAD index (33.53), root length (4.96cm), fresh weight (12.33g), dry weight (1.24g) and moisture content percentage (89.95%) was recorded under soil: cocopeat: vermicompost (1:1:1) in pansy. The equal ratio of soil: sand: vermicompost (10.33%) reported significantly highest dry matter percentage, whereas lowest percentage was observed in equal ratio of soil: cocopeat: vermicompost (10.05%).

Among seed treatment x media interaction, maximum shoot length (5.75cm), number of leaves (8.00), SPAD index (34.43), root length (5.38 cm), fresh weight (14.04g) and dry weight (1.42 g) was recorded in GA₃ @ 25 ppm + soil: cocopeat: vermicompost (1:1:1) in pansy. Among seed treatment x media interaction, KNO₃ @ 0.2% + equal proportion of soil: sand: leaf

manure (11.09%) recorded significantly highest dry matter percentage. The maximum significant moisture content percentage (90.23%) was observed in GA₃ @ 50 ppm + soil: sand: leaf manure (1:1:1) followed by KNO₃ @ 0.2% + soil: leaf manure (1:1) and KNO₃ @ 0.1% + soil: cocopeat: vermicompost (1:1:1) which were at par.

In this study pre-sowing treatment with gibberellic acid especially GA₃ @ 25 ppm significantly enhanced subsequent seedling growth in pansy viz. shoot and root length, number of leaves per seedling, fresh and dry weight of seedlings and SPAD index in pansy. This may be due to the positive effects of GA₃ in enhancement of cell division and enlargement in cambium tissue [11]. Similar results were reported in annual chrysanthemum by Thakur et al. [12] and in marigold by Kumar et al. [13]. The higher fresh and dry weight in GA₃ treatments is chiefly because of increased mobilization of water, membrane permeability, nutrient uptake and transport which leads to higher production of photosynthesis products [11,14] GA₃ increases Ca²⁺ ion in the leaf cells which helps to keep water balance and maintain high RWC of leaf [15]. This accelerates root and shoot length, fresh and dry weight and increases leaf water content as earlier reported by Shahzad et al. [16]. GA₃ and thiourea both increased significantly moisture content as it is well known that both enter the seeds same as water and help in inducing the relative water content which helps in breaking dormancy, stimulating rooting and inducing growth of seedlings [17]. GA₃ also increases the somatic absorption of nutrients, which leads to cell elongation and thus increases the main root length and the number of secondary roots.

The medium with vermicompost and cocopeat is more suitable because of better physical properties and enhanced nutrient level, provides a better growth medium for plant establishment [18,13]. This treatment combination due to proper aeration in the root zone of the seedling produces better quality seedlings. The improved seedling growth observed in media containing soil, cocopeat and vermicompost (1:1:1) can also be attributed to several factors such as optimal highest water holding capacity (220.10%), total porosity (80%), ideal total nitrogen percentage (0.12%), available phosphorus percentage (0.61%) and available potassium percentage (1.95%) facilitating superior performance across all traits (Fig. 1).

Table 1. Individual effect of seed priming and growing media on seedling growth traits in pansy (*Viola tricolor*)

Treatments	Shoot length (cm)	No. of leaves per plant	SPAD index	Root length (cm)	Root: shoot ratio	Fresh weight (g)	Dry weight (g)	Moisture content (%)	Dry matter (%)
T ₁ (Water or control)	4.17 ^F	5.67 ^D	31.55 ^E	4.22 ^E	0.99 ^C	8.33 ^F	0.86 ^E	89.67 ^{BC}	10.32 ^{AB}
T ₂ (Thiourea @ 50 ppm)	4.47 ^E	5.95 ^{CD}	31.61 ^E	4.40 ^D	1.02 ^B	8.54 ^E	0.85 ^E	90.05 ^A	9.99 ^C
T ₃ (KNO ₃ @ 0.1%)	4.52 ^D	6.06 ^B	32.30 ^D	4.44 ^{CD}	1.02 ^B	12.74 ^D	1.14 ^D	89.74 ^{BC}	10.27 ^{AB}
T ₄ (KNO ₃ @ 0.2%)	4.65 ^C	6.72 ^B	32.52 ^C	4.53 ^{BC}	1.03 ^{AB}	11.50 ^C	1.20 ^C	89.59 ^C	10.41 ^A
T ₅ (GA ₃ @ 25 ppm)	5.00 ^A	7.28 ^A	33.08 ^A	4.79 ^A	1.04 ^A	12.94 ^A	1.31 ^A	89.87 ^A	10.13 ^{BC}
T ₆ (GA ₃ @ 50ppm)	4.84 ^B	7.22 ^A	32.80 ^B	4.69 ^A	1.04 ^{AB}	12.80 ^A	1.29 ^{AB}	89.89 ^{AB}	10.10 ^{BC}
T ₇ (GA ₃ @ 75ppm)	4.61 ^C	6.67 ^B	32.20 ^D	4.55 ^B	1.01 ^B	12.43 ^B	1.27 ^B	89.75 ^{AB}	10.25 ^{AB}
Media									
M1: Soil: FYM (1:1)	4.33 ^E	5.86 ^C	31.23 ^F	4.30 ^D	1.01 ^B	10.43 ^D	1.07 ^D	89.74 ^{AB}	1.07 ^D
M2= Soil: sand: vermicompost (1:1:1)	4.54 ^C	6.33 ^B	31.73 ^E	4.41 ^C	1.03 ^{AB}	11.12 ^C	1.15 ^C	89.67 ^B	1.15 ^C
M3= Soil: sand: FYM (1:1:1)	4.45 ^D	6.29 ^B	31.96 ^D	4.42 ^C	1.01 ^B	10.56 ^D	1.08 ^D	89.81 ^{AB}	1.08 ^D
M4= Soil: sand: leaf manure (1:1:1)	4.45 ^D	6.38 ^B	32.31 ^C	4.37 ^{CD}	1.02 ^B	10.42 ^D	1.07 ^D	89.74 ^{AB}	1.07 ^D
M5= Soil: cocopeat: vermicompost (1:1:1)	5.04 ^A	7.24 ^A	33.53 ^A	4.96 ^A	1.02 ^B	12.33 ^A	1.24 ^A	89.95 ^A	1.24 ^A
M6= Soil: leaf manure (1:1)	4.85 ^B	6.95 ^A	32.99 ^B	4.64 ^B	1.04 ^A	11.73 ^B	1.19 ^B	89.84 ^{AB}	1.19 ^B

*In a column, means followed by same letters do not differ significantly at the 5% level by Duncan's Multiple Range Test.

Table 2. Combined effect of seed priming and media on seedling growth traits in pansy (*Viola tricolor*)

Media and seed priming treatments	Shoot length (cm)	No. of leaves per plant	SPAD index	Root length (cm)	Root: shoot ratio	Fresh weight (g)	Dry weight (g)	Moisture content (%)	Dry matter (%)
T ₁ M ₁	3.98 ^r	4.33 ^f	30.00 ^p	4.08 ^h	0.98 ^b	7.95 ^t	0.85 ^m	89.27 ^{ab} (70.88)	0.85 ^m
T ₁ M ₂	4.07 ^r	5.67 ^f	30.17 ^p	4.07 ^h	1.00 ^{ab}	8.21 ^t	0.89 ^m	89.15 ^{ab} (70.77)	0.89 ^m
T ₁ M ₃	4.15 ^r	5.67 ^f	31.97 ^m	4.33 ^h	0.96 ^b	7.82 ^t	0.78 ^m	89.99 ^{ab} (71.55)	0.78 ^m
T ₁ M ₄	4.14 ^r	5.33 ^f	32.10 ^l	4.11 ^h	1.01 ^{ab}	7.69 ^t	0.79 ^m	89.77 ^{ab} (71.43)	0.79 ^m
T ₁ M ₅	4.37 ^o	6.67 ^e	32.93 ⁱ	4.43 ^h	0.99 ^{ab}	9.32 ^q	0.94 ^l	89.95 ^{ab} (71.52)	0.94 ^l
T ₁ M ₆	4.30 ^p	6.33 ^e	32.17 ^l	4.28 ^h	1.01 ^{ab}	8.97 ^r	0.90 ^m	89.93 ^{ab} (71.50)	0.90 ^m
T ₂ M1	4.14 ^r	5.00 ^f	30.30 ^p	4.06 ^h	1.02 ^{ab}	7.90 ^t	0.79 ^m	90.01 ^{ab} (71.57)	0.79 ^m
T2M2	4.55 ^m	6.00 ^f	30.57 ^p	4.43 ^h	1.03 ^{ab}	8.59 ^s	0.86 ^m	89.99 ^{ab} (71.56)	0.86 ^m
T2M3	4.47 ^o	5.67 ^f	31.50 ⁿ	4.33 ^h	1.03 ^{ab}	7.93 ^t	0.79 ^m	90.03 ^{ab} (71.60)	0.79 ^m
T2M4	4.37 ^o	6.00 ^f	32.13 ^l	4.31 ^h	1.01 ^{ab}	7.89 ^t	0.78 ^m	90.08 ^a (71.64)	0.78 ^m
T2M5	4.70 ⁱ	6.67 ^e	32.73 ^j	4.75 ^e	0.99 ^{ab}	9.88 ^p	0.96 ^k	90.28 ^{ab} (71.84)	0.96 ^k
T2M6	4.61 ^k	6.33 ^e	32.40 ^k	4.51 ^h	1.02 ^{ab}	9.03 ^q	0.93 ^m	89.70 ^{ab} (71.28)	0.93 ^m
T ₃ M1	4.27 ^q	5.67 ^f	31.00 ^o	4.18 ^h	1.02 ^{ab}	10.36 ^o	1.07 ^j	89.71 ^{ab} (71.29)	1.07 ^j
T3M2	4.49 ^o	6.00 ^f	32.27 ^l	4.44 ^h	1.01 ^{ab}	11.25 ^m	1.15 ^h	89.74 ^{ab} (71.32)	1.15 ^h
T3M3	4.37 ^o	5.67 ^f	31.30 ⁿ	4.33 ^h	1.01 ^{ab}	10.62 ^o	1.11 ⁱ	89.55 ^{ab} (71.14)	1.11 ⁱ
T3M4	4.33 ^p	5.67 ^f	32.33 ^k	4.26 ^h	1.02 ^{ab}	10.26 ^o	1.07 ^j	89.58 ^{ab} (71.16)	1.07 ^j
T3M5	4.93 ^e	6.67 ^e	33.60 ^d	4.90 ^d	1.01 ^{ab}	12.46 ^j	1.24 ^g	90.07 ^a (71.64)	1.24 ^g
T3M6	4.72 ^h	6.67 ^e	33.27 ^f	4.54 ^h	1.04 ^{ab}	11.95 ^l	1.22 ^g	89.76 ^{ab} (71.34)	1.22 ^g
T4 M1	4.37 ^o	6.00 ^f	31.87 ^m	4.40 ^h	0.99 ^{ab}	10.71 ⁿ	1.13 ^h	89.48 ^{ab} (71.07)	1.13 ^h
T4 M2	4.55 ^m	6.33 ^e	32.07 ^l	4.47 ^h	1.02 ^{ab}	11.35 ^m	1.18 ^h	90.08 ^a (71.64)	1.18 ^h
T4 M3	4.51 ⁿ	7.00 ^d	32.03 ^l	4.38 ^h	1.03 ^{ab}	10.40 ^o	1.07 ^j	89.58 ^{ab} (71.16)	1.07 ^j
T4 M4	4.49 ^o	6.67 ^e	32.20 ^l	4.32 ^h	1.04 ^{ab}	10.71 ⁿ	1.19 ^h	88.91 ^b (70.54)	1.19 ^h
T4 M5	5.05 ^d	7.33 ^c	33.83 ^c	4.98 ^c	1.02 ^{ab}	13.11 ^f	1.34 ^c	89.75 ^{ab} (71.33)	1.34 ^c
T4 M6	4.92 ^f	7.00 ^d	33.10 ^h	4.63 ^f	1.06 ^{ab}	12.73 ⁱ	1.26 ^f	90.08 ^a (71.64)	1.26 ^f
T5 M1	4.66 ^j	6.67 ^e	32.23 ^l	4.49 ^h	1.04 ^{ab}	12.22 ^j	1.24 ^g	89.83 ^{ab} (71.40)	1.24 ^g
T5M2	4.93 ^e	7.00 ^d	32.57 ^j	4.66 ^f	1.06 ^{ab}	13.02 ^g	1.33 ^d	89.81 ^{ab} (71.38)	1.33 ^d
T5M3	4.65 ^j	7.00 ^d	32.53 ^j	4.58 ^g	1.01 ^{ab}	12.68 ⁱ	1.29 ^e	89.80 ^{ab} (71.37)	1.29 ^e
T5M4	4.71 ^h	7.33 ^c	33.20 ^g	4.65 ^f	1.01 ^{ab}	12.22 ^j	1.23 ^g	89.93 ^{ab} (71.50)	1.23 ^g
T5M5	5.75 ^a	8.00 ^a	34.43 ^a	5.38 ^a	1.07 ^{ab}	14.04 ^a	1.42 ^a	89.86 ^{ab} (71.43)	1.42 ^a
T5M6	5.32 ^b	7.67 ^b	33.50 ^e	4.99 ^c	1.07 ^{ab}	13.44 ^d	1.35 ^c	89.98 ^{ab} (71.54)	1.35 ^c

Media and seed priming treatments	Shoot length (cm)	No. of leaves per plant	SPAD index	Root length (cm)	Root: shoot ratio	Fresh weight (g)	Dry weight (g)	Moisture content (%)	Dry matter (%)
T6 M1	4.52 ^m	7.00 ^d	31.93 ^m	4.44 ^h	1.02 ^{ab}	12.11 ^k	1.21 ^h	90.03 ^{ab} (71.60)	1.21 ^h
T6M2	4.77 ^g	6.67 ^e	32.40 ^k	4.41 ^g	1.09 ^a	13.10 ^g	1.35 ^c	89.72 ^{ab} (71.30)	1.35 ^c
T6M3	4.62 ^k	7.00 ^d	32.40 ^k	4.58 ^g	1.01 ^{ab}	12.35 ^j	1.24 ^g	89.96 ^{ab} (71.53)	1.24 ^g
T6M4	4.59 ^l	7.33 ^c	32.40 ^k	4.55 ^h	1.01 ^{ab}	12.10 ^k	1.18 ^h	90.23 ^a (71.78)	1.18 ^h
T6M5	5.37 ^b	8.00 ^a	34.07 ^b	5.27 ^a	1.02 ^{ab}	13.89 ^b	1.42 ^a	89.75 ^{ab} (71.33)	1.42 ^a
T6M6	5.18 ^c	7.33 ^c	33.57 ^d	4.90 ^d	1.06 ^{ab}	13.24 ^e	1.36 ^b	89.70 ^{ab} (71.28)	1.36 ^b
T7 M1	4.34 ^p	6.33 ^e	31.30 ⁿ	4.43 ^h	0.98 ^{ab}	11.74 ^l	1.19 ^h	89.86 ^{ab} (71.43)	1.19 ^h
T7M2	4.41 ^o	6.67 ^e	32.03 ^l	4.39 ^h	1.00 ^{ab}	12.31 ^j	1.27 ^f	89.70 ^{ab} (71.28)	1.27 ^f
T7M3	4.38 ^o	6.00 ^f	32.00 ^l	4.40 ^h	1.00 ^{ab}	12.10 ^k	1.26 ^g	89.59 ^{ab} (71.18)	1.26 ^g
T7M4	4.51 ⁿ	6.33 ^e	31.83 ^m	4.42 ^h	1.02 ^{ab}	12.06 ^k	1.24 ^g	89.69 ^{ab} (71.27)	1.24 ^g
T7M5	5.08 ^d	7.33 ^c	33.10 ^h	5.01 ^b	1.01 ^{ab}	13.59 ^c	1.36 ^b	89.97 ^{ab} (71.53)	1.36 ^b
T7M6	4.92 ^f	7.33 ^c	32.93 ⁱ	4.66 ^f	1.06 ^{ab}	12.78 ^h	1.32 ^d	89.70 ^{ab} (71.28)	1.32 ^d

*The values in the parenthesis are square root transformed. In a column, means followed by same letters do not differ significantly at the 5% level by Duncan's Multiple Range Test.

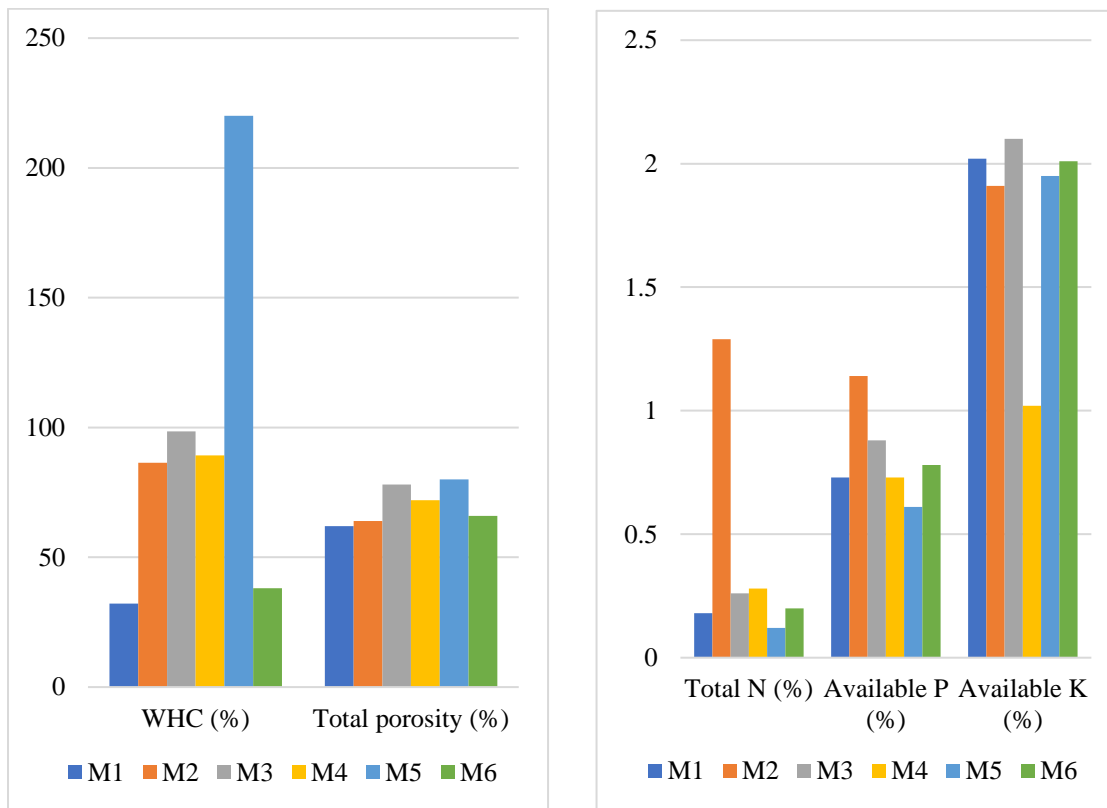


Fig. 1. Media analysis for different physical and chemical properties

4. CONCLUSION

Thus overall, it was observed that the best seed treatment for raising seedlings in pansy was GA₃ @ 25 ppm and best media was soil: cocopeat: vermicompost (1:1:1). Among the seed treatment x media interaction, treatment comprised of GA₃ @ 25 ppm + soil: cocopeat: vermicompost (1:1:1) was found to be the best for almost all parameters as compared to the other treatments.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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