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Effect of organic and inorganic substances on plant growth and survival in khirni (*Manilkara hexandra*)

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Abstract

The study was carried out to find out the effect of organic and inorganics on growth and survival of khirni (*Manilkara hexandra* L.) at Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, during 2023-2024. Among treatment combinations, seeds soaked in cow dung slurry for 24 hr showed better stem diameter (3.18 mm), seedling vigour index I (3122.55) and seedling vigour index II (107.92), survival (93.42 %) and lesser incidence of damping off (6.58 %), whereas seedling height (18.04 cm), number of leaves (9.97), leaf area (21.36 cm^2), plant fresh weight (3.09 g) and plant dry weight (1.44 g) were observed best in treatment seeds soaked in GA_3 300 ppm for 12 hr.

Key words: Cow dung, Cow urine, Gibberellic acid, Thiourea, Potassium nitrate.

Khirni (*Manilkara hexandra* L.) belonging to the family Sapotaceae, is a native of tropical South-East Asia. The major khirni growing states in our country are Madhya Pradesh. Gujarat, Rajasthan, Karnataka, Maharashtra and Tamil Nadu. It is mainly propagated by seeds. It is drought hardy and slow growing species commonly grown in laterite soil. It is used as rootstock for sapota propagation.

The non-availability of sufficient rootstock of khirni in southern region of Maharashtra is a limiting factor and it is due to less germination percentage, slow growth of seedlings to attain the graftable size. An attempts has been made to improve the germination of its seeds and subsequent growth. The use of bioregulators in enhancing seed germination and seedling growth of numerous plant species is well known (Malshe *et al.* 2014). Beside, synthetic chemicals and other naturally available bio-products of organics (cow dung and cow urine) are known to contain vital plant growth substance, which enhance the growth and development of plants. Keeping in view, an experiment was conducted to see effect of different chemicals, plant growth regulators, cow-dung slurry and cow urine on germination, growth and development of khirni seeds (Shinde and Malshe, 2015).

The seeds were sown in 20 cm x 15 cm size polythene bags. They were filled with potting mixture, *ie*. soil, FYM and sand (2:1:1 ratio) and uniform sized healthy pre-treated khirni seeds by organics and inorganic substances were sown in bags which were then properly labelled with tags for observation. The Randomized Block Design with 13 treatments and 3 replications was used. The treatments were T_1: seed soaking in cow urine (20 %) for 12 hrs, T_2: seed soaking in cow urine (20 %) for 24 hrs, T_3: seed soaking in cow dung slurry for 12 hrs (1:2 cow dung + water), T_4: seed soaking in cow dung slurry for 24 hrs (1:2 cow dung + water), T_5: seed soaking in cow urine (20 %) for 12 hrs + cow dung slurry for 12 hrs, T_6: seed soaking in GA_3 @ 100 ppm for 12 hrs, T_7: seed soaking in GA_3 @ 200 ppm for 12 hrs, T_8: seed soaking in GA_3 @ 300 ppm for 12 hrs, T_9: seed soaking in KNO_3 (1 %) for 12 hrs, T_{10}: seed soaking in KNO_3 (2 %) for 12 hrs, T_{11}: seed soaking in Thiourea (1 %) 12 hrs, T_{12}: seed soaking in Thiourea (2 %) for 12 hrs, T_{13}: Control (without soaking).

Observations on growth and survival percentage were taken. The statistical analysis was done by following the ANOVA technique (Panse and Sukhatme, 1967). The data pertaining on seedling height of khirni at 60 and 180 days after sowing influenced by different organics and chemicals. There was significant effect of chemicals and organics on seedling height (Table 1). At 60 days after sowing maximum seedling height (6.01 cm) was recorded in treatment T_4 (Seed soaking in cow dung slurry for 24 hrs) which was statistically at par with treatment T_8 (5.56 cm) and T_5 (5.49 cm), while minimum seedling height (4.24 cm) was recorded in treatment T_{13} (control). At 180 DAS, maximum seedling height (18.04 cm) was recorded in T_8 (seed soaking in GA_3 @ 300 ppm for 12 hrs) which was statistically at par with T_7 (17.57 cm),T_4 (17.50 cm) and T_5 (17.13 cm), while minimum seedling height (11.26 cm) was recorded in treatment T_{13} (control).

The increase in seedling height was due to effect of GA_3 which stimulates vegetative growth by cell multiplication and cell elongation. It is also reported by Lockhart (1960) that GA_3 induces plasticity in cell wall

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Table . 1: Effect of organic and inorganic substances on plant growth and survival in khirni.

Treatment	Seedling height (cm)		Stem diameter (mm)		Number of leaves		Leaf area (cm2)		Plant fresh weight (g)	Plant dry weight (g)	Seedling Vigour index I	Seedling Vigour index II	Survival (%)	Incidence of damping off (%)
	60 DAS	180 DAS	60 DAS	180 DAS	60 DAS	180 DAS	60 DAS	180 DAS						
T_1	5.12	16.4	1.25	2.74	2.33	7.42	2.85	18.23	2.11	0.91	2454.08	58.61	81.14	18.86
T_2	5.20	16.49	1.26	2.78	2.25	7.42	2.92	18.36	2.27	0.98	2597.74	67.24	81.69	18.31
T_3	5.36	16.82	1.28	2.8	2.51	8.60	3.05	19.75	2.9	1.29	2688.32	90.21	88.04	11.96
T_4	**6.01**	**17.50**	**1.43**	**3.18**	**2.92**	9.22	**3.39**	20.43	3.01	1.41	3122.55	107.92	93.42	6.58
T_5	5.49	**17.13**	1.31	2.85	2.60	8.26	3.13	19.27	2.49	1.10	3046.26	79.00	88.27	11.73
T_6	4.95	16.14	1.23	2.81	2.11	8.15	2.70	18.83	2.38	1.06	2361.06	65.57	82.17	17.83
T_7	5.06	**17.57**	1.24	2.88	2.22	8.49	2.80	19.42	2.74	1.16	2518.24	73.26	85.18	14.82
T_8	5.56	**18.04**	1.35	3.02	2.72	**9.97**	3.21	**21.36**	3.09	1.44	3073.94	106.28	90.72	9.28
T_9	4.90	15.45	1.21	2.68	2.01	7.09	2.66	17.5	1.89	0.83	1987.52	45.83	75.71	24.29
T_{10}	4.93	15.73	1.22	2.71	2.06	7.20	2.68	17.75	2.05	0.88	2195.3	52.76	80.50	19.5
T_{11}	4.78	14.89	1.19	2.67	1.55	6.42	2.48	16.92	1.68	0.70	1815.41	35.87	73.89	26.11
T_{12}	4.81	15.14	1.21	2.68	2.00	6.87	2.59	17.14	1.79	0.79	1901.65	42.14	77.89	22.11
T_{13}	4.24	11.26	1.02	2.31	1.33	6.31	2.28	16.00	1.52	0.58	1434.56	27.88	71.67	28.33
Mean	5.11	16.04	1.24	2.77	2.20	7.80	2.83	18.45	2.3	1.01	2399.74	65.58	82.33	17.67
SEm(±)	0.22	0.37	0.05	0.12	0.14	0.50	0.18	0.66	0.13	0.05	132.09	4.43	3.55	1.33
CD (5 %)	0.63	1.08	015	0.36	0.41	1.46	0.53	1.93	0.38	0.15	385.57	12.92	10.36	3.88

similar to that of auxins. Thus, it creates water diffusion pressure deficit which results in water-uptake, causing cell elongation and increasing seedling height. These results align with those of Vachhani *et al.* (2014) and Dilip *et al.* (2017).

At 60 DAS, T_4 (seed soaking in cow dung slurry for 24 hrs) recorded maximum number of leaves/plant (2.92) which was statistically at par with T_8 (2.72), T_5 (2.60) and T_3 (2.51). The lowest number of leaves/plant (1.33) was recorded in treatment T_{13} (control). The treatment T_8 (seed soaking in GA_3 @ 300 ppm for 12 hrs) showed highest number of leaves/plant (9.97) at 180 DAS, which was statistically at par with treatment T_4 (9.92) and T_4 (8.60). The least number of leaves/plant (6.31) was in treatment T_{13} (control). The maximum number of leaves was in GA_3 treatment due to its presence at apical meristem which results in more synthesis of nucleoprotein responsible for increasing leaf initiation (Sen and Gunthi, 1976). Similar findings were recorded by Sable and Waskar (2009) and Vachhani *et al* (2014).

At 60 DAS maximum leaf area (3.39 cm^2) was recorded in T_4 (seed soaking in cow dung slurry for 24 hrs) which was statistically at par with T_8 (3.21 cm^2), T_5 (3.13 cm^2), T_3 (3.05 cm^2) and T_2 (2.92 $cm^2$2.92 cm^2). The minimum leaf area (2.28 cm^2) was recorded in treatment T_{13} (control). At 180 days after seed sowing maximum seedling height (21.36 cm^2) was recorded in T_8 (seed soaking in GA_3 @ 300 ppm for 12 hrs) which was statistically at par with T_4 (20.43 cm^2) and T_3 (19.75 cm^2) The minimum leaf area (16.00 cm^2) was recorded in treatment T_{13} (control). The increase in leaf area of khirni is due to seeds treated with GA_3. The activity of GA_3 at the apical meristem resulting in more synthesis and accumulation of nucleoprotein responsible for increasing leaf initiation and leaf area expansion (Sen and Gunthi, 1976). The similar findings were recorded with Vachhani *et al.* (2014).

The stem diameter (1.43 mm) at 60 days from seed sowing was maximum in T_4 (seed soaking in cow dung slurry for 24 hrs) which was statistically at par with T_8 (1.35 mm), T_5 (1.31 mm) and T_3 (1.28 mm), while minimum stem diameter (1.02 mm) was recorded in T_{13} (control). Similar trend was observed for stem diameter at 180 days after sowing seed. The increase in stem diameter is due to presence of nitrogen, phosphorus and potassium, essential for plant growth (Khan *et al.* 2010) in cowdung. It was found that increased in stem girth was related to increase in leaf area. It seemed possible that increase in leaf area increased photosynthetic activities and the photosynthatates might have been utilized in increasing girth of stem (Mishra and Varma 1980).

The maximum plant fresh weight (3.09 g) at 180 days after sowing was found in T_8 (seed soaking in GA_3 @ 300 ppm for 12 hrs) which was at par with T_4 (3.01 g), T_3 (2.90 g), while minimum plant fresh weight (1.52 g) was recorded under T_{13} (control).

The increase in fresh weight was observed in seedling treated with GA_3 which resulted in mobilization of water and nutrients transport at higher rate. This might be due to primary cause of stem elongation that enhances more vigour and growth. These results are in confirmation with those of Bajaniya *et al*. (2018), Sable and Waskar (2009). The maximum plant dry weight was noticed in treatment T_8 (1.44 g) which was at par with T_4 (1.41 g), T_3 (1.29 g), whereas the minimum plant dry weight (0.58 g) was recorded under treatment T_{13} (control). The maximum seedling vigour index- I (3122.55) at 180 DAS was found in T_4 (seed soaking in cow dung slurry for 24 hrs), which was at par with T_8 (3073.94) and T_5 (3046.26). The minimum seedling vigour index- I (1434.56) was recorded in T_{13} (control).

At 180 days of sowing maximum seedling vigour index- II (107.92) was found in T_4 (seed soaking in cow dung slurry for 24 hrs), which was at par with treatments T_8 (106.28). The minimum seedling vigour index- II (27.88) was recorded in treatment T_{13} (control). Seeds treated with cowdung showed the maximum improvement in vigour index of the khirni rootstock. This increase is likely due to the essential nutrients in cow dung such as nitrogen, phosphorus and potassium, essential for plant growth (Khan *et al*. 2010). These nutrients probably enhanced seedling vigour, resulting in better growth characteristics, including more plant height, stem diameter, number of leaves, and leaf area. The similar results were recorded by Desai (1988). The highest survival percentage (93.42 %) was found in T_4 (seed soaking in cow dung slurry for 24 hrs), which was at par with T_8 (90.72 %) , T_5 (88.27 %) and T_3 (88.04 %)**.** The least survival percentage (71.67 %) was recorded in T_{13} (control).

The treatment T_4 (seed soaking in cow dung slurry for 24 hrs) showed lowest incidence of damping off (6.58 %), which was at par with T_8 (9.28 %) seed soaking in GA_3 @ 300 ppm for 12 hrs. The highest incidence of damping off (28.33 %) was recorded in T_{13} (control).

The increase in survival percentage and decrease of damping percentade is due to seed treated with cowdung which contain nutrients, such as nitrogen, phosphorus and potassium, essential for plant growth (Khan *et al*. 2010) in addition to these nutrients, cow dung contains plant growth-promoting bacteria (PGPB) which can further enhance plant growth (Mukhuba *et al*. 2018). This PGPB live in rhizosphere (area around plant roots) and help promote plant growth by improving nutrient uptake, reducing plant stress and protecting against pathogens (Bashan and De-Bashan, 2005) which increase the vigour of seedlings, which intern increases survival percentage of seedling. The results are in close conformity with findings of Desai (1988) and Patel *et al*. (1996) in khirni.

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