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Effect of storage methods and seed rhizome treatment on the field performance of ginger

A Shadap*, N K Hegde & Y A Lyngdoh

Department of Spices and Plantation Crops,
K.R.C. College of Horticulture, Arabhavi-591 310, Karnataka.
University of Agricultural Sciences, Dharwad.
**E-mail: arwan_s@rediffmail.com*

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Abstract

An experiment was conducted to evaluate the effect of different storage methods and seed rhizome treatment on the field performance of ginger var. Humnabad. Four storage methods were selected for the study *viz*., rhizomes kept in sand layers (indoor), 250 gauge polyethylene bag with 0.5% vents (indoor), Zero energy cool chamber (ZECC) either in open condition or in polyethylene bag with 0.5% vents. The seed rhizomes were treated with fungicide *viz*., Ridomil MZ (3 g L^{-1}), bio-control agent *Trichoderma harzianum* (5 g kg^{-1} seed rhizome) and no seed treatment as the control. Highest germination (98.89%), plant height (52.3 cm), leaf area index (25.75), number of tillers $clump^{-1}$ (19.7), pseudostem girth (3.41 cm) and fresh rhizome yield (22.35 t ha^{-1}) were recorded in rhizome stored in ZECC treated with *T. harzianum* whereas, the rhizome stored in sand layer with no seed treatment recorded the lowest levels of germination (75.56%), plant height (33.6 cm), leaf area index (9.73), number of tillers $clump^{-1}$ (12.6), pseudostem girth (2.32 cm) and fresh rhizome yield (11.84 t ha^{-1}).

Keywords: ginger, growth, seed rhizome, storage and yield

Ginger (*Zingiber officinale* Rosc.) is propagated vegetatively using rhizomes and nearly 17-20% of the produce is retained and stored annually for subsequent crop as seed rhizome. From the time of harvesting of rhizome (January-February) till subsequent planting (May-June) the seed rhizomes are to be stored (3 to 3½ months) in healthy and viable condition. During the period of storage, due to desiccation, sprouting and incidence of insects and diseases, recovery of healthy rhizome for planting in the next season is reduced considerably which results in poor performance of the crop in the field. Hence, the present investigation was undertaken to study the effect of storage methods and seed rhizome treatment on the growth and yield of ginger.

The experiment was carried out during 2010 at Kittur Rani Channamma College of Horticulture, Arabhavi, Gokak (Tq), Karnataka. The experiment was laid out in two factorial completely randomized design (FCRD) with three replications. Three kg healthy, uniform size seed rhizomes of ginger var. 'Humnabad' were used for the study. The seed

rhizomes were stored for 90 days starting from first week of March till last week of May. The methods of storage included in Factor 1 were M_1: Sand layers (indoor condition), M_2: 250 gauge polyethylene bag with 0.5% vents (indoor condition), M_3: Zero energy cool chamber (ZECC) and M4: ZECC + polyethylene bag with 0.5% vents and three levels of seed rhizome as Factor 2 were S_1: Control (no seed treatment), S_2: Ridomil MZ (3 g L^{-1}) and S_3: *Trichoderma harzianum* (5 g kg^{-1} seed rhizome). At the end of the storage period (90 days), 30 randomly selected rhizomes weighing 25 g each, from each of the 12 treatment combinations, were planted on raised beds of size 3 m × 1 m × 15 cm at a spacing of 30 × 20 cm for three replications. FYM @ 25 t ha^{-1} was applied to all the beds before planting and mixed well with the soil. The recommended dose of fertilizer (i.e., 100, 50 and 50 kg NPK ha^{-1}) was applied in three splits. Full dose of P and K were applied as basal dose. Nitrogen was top dressed in equal splits after weeding at 30 days and 60 days of planting (DAP). The other cultural operations were carried out as per the recommended package of practices (Anon. 2007). Sunhemp was also sown along the border of each bed to provide partial shade during the initial establishment of the crop. Days to first germination/ sprouting was noted and taken as days to first germination. Observations on growth attributes *viz.*, plant height, number of leaves $clump^{-1}$, number of tillers $clump^{-1}$, leaf area index and pseudostem girth were recorded at 150 DAP.

Leaf area index (LAI) was computed using the formula given below (Sestak *et al*. 1971).

LAI= [Leaf area of the entire clump (cm^2)] / [Spacing provided (cm^2)]

Leaf area of the entire clump was calculated by multiplying total number of leaves with individual leaf size and expressed in cm^2 and the leaf size was computed by multiplying leaf length, width and conversion factor (0.666) to arrive at the actual leaf size (Reddy & Reddy 1995). Girth of the tallest tiller at the collar region was measured using digital calliper and expressed in cm as pseudostem girth. Sprouting percentage was calculated by counting the number of sprouts that emerged at 45th DAP in each bed and percentage of sprouting was calculated by using the formula;

Sprouting (%) = (Number of rhizome sprouted / Number of rhizome planted per bed) × 100

The rhizome stored under ZECC recorded highest germination (97.78%) followed by rhizome stored under 250 gauge polyethylene bag with 0.5% vents (88.89%) compared to the lowest germination by rhizome stored under sand layer (83.70%). Chandrappa (1996) also recorded more than 80% sprouting in ginger rhizomes stored in 100 gauge white polyethylene bags. Similar results were obtained in turmeric by Kirankumar (2001) and Vanamala (1994) where lower percentage of sprouting was recorded in turmeric rhizomes, stored in heap covered with sand. Maximum germination was recorded in the rhizome treated with *T. harzianum* @ 5 g kg^{-1} seed rhizome (93.06%) closely followed by rhizome treated with 0.3% Ridomil MZ (88.06%), while the lowest was observed in the control with no seed treatment (84.17%). Among the treatment combinations, maximum germination was recorded in M_3S_3 (98.89%) closely followed by M_3S_2 (97.78%) i.e., rhizome stored under ZECC after treating with 0.3% Ridomil MZ whereas, the rhizome stored in sand layer with no seed treatment (M_1S_1) recorded the lowest germination (75.56%). The seed rhizome treatment with *T. harzianum* significantly influenced the germination percentage which might be due to favourable effect of the bioagent on germination. Similar results were obtained by Sharma *et al.* (1991) in ginger and Kirankumar (2001) in turmeric. Irummukhtar (2008) reported that *T. harzianum* is highly effective in enhancing the germination of okra seeds. Sharma *et al*. (1991) reported that *T. viride* in combination with Ridomil MZ gave greater protection against rhizome rot and also gave higher yield, when given as a seed treatment.

The crop raised from the seed rhizome stored under ZECC recorded significantly higher growth parameters like plant height (49.8 cm),

Table 1. Effect of storage methods and seed rhizome treatments on sprouting percentage at 45th day after planting (DAP), plant height (cm) and number of leaves clump^{-1} at 150 DAP in ginger var. 'Humnabad'.

Treatment	Sprouting percentage (45th DAP)					Plant height (cm)					Number of leaves clump^{-1}				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
S_1	75.56 (8.72)	84.44 (9.22)	96.67 (9.86)	80.00 (8.97)	84.17 (9.19)	33.6	38.1	46.6	35.9	38.6	252.7	315.5	391.9	304.4	316.1
S_2	85.56 (9.26)	88.89 (9.45)	97.78 (9.91)	80.00 (8.96)	88.06 (9.39)	35.9	40.2	50.5	39.2	41.4	309.4	359.6	418.5	353.4	360.2
S_3	90.00 (9.51)	93.33 (9.68)	98.89 (9.97)	90.00 (9.50)	93.06 (9.67)	39.8	49.8	52.3	48.4	47.6	345.9	398.9	492.6	361.1	399.7
Mean	83.70 (9.16)	88.89 (9.45)	97.78 (9.91)	83.33 (9.14)	88.43 (9.42)	36.4	42.7	49.8	41.2	42.5	302.7	358.0	434.3	339.6	358.7

	S.Em±	CD (P<0.05)	S.Em±	CD (P<0.05)	S.Em±	CD (P<0.05)
M	0.113	0.330	1.487	4.36	19.985	58.62
S	0.097	0.286	1.288	3.78	17.308	50.76
M × S	0.195	0.572	2.575	7.55	34.616	101.53

Figures in parentheses indicate square root transformed values

Storage methods (M)

M_1- Sand layer

M_2 - 250 gauge polyethylene bag with 0.5% vents

M_3 - Zero energy cool chamber (ZECC)

M_4 - ZECC + polyethylene bag with 0.5% vents

Seed treatment (S)

S_1 - Control

S_2 - Ridomil MZ (3 g L-1)

S_3 - *Trichoderma harzianum* (5 g kg^{-1} seed rhizome)

Table 2. Effect of storage methods and seed rhizome treatment on leaf area index, number of tillers clump^{-1}, pseudostem girth (cm) and yield in ginger var. 'Humnabad' at 150 DAP

Treatment	Leaf area index					Number of tillers clump^{-1}					Pseudostem girth (cm)					Fresh rhizome yield (t ha^{-1})				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
S_1	9.73	13.69	19.53	13.42	14.09	12.60	15.50	17.20	15.20	15.10	2.32	2.51	2.84	2.46	2.54	11.84	15.94	19.21	15.36	15.59
S_2	12.07	14.72	22.13	15.54	16.12	15.30	16.30	17.60	16.30	16.40	2.38	2.62	3.16	2.59	2.69	13.49	17.51	20.07	15.75	16.70
S_3	15.01	20.37	25.75	19.25	20.09	15.90	16.90	19.70	16.50	17.30	2.57	3.24	3.41	3.20	3.11	14.77	20.48	22.35	17.78	18.84
Mean	12.27	16.26	22.47	16.07	16.77	14.60	16.20	18.20	16.00	16.20	2.42	2.79	3.14	2.75	2.78	13.37	17.98	20.54	16.29	17.04

	S.Em±	CD (P<0.05)	S.Em±	CD (P<0.05)	S.Em±	CD (P<0.05)	S.Em±	CD (P<0.05)
M	1.51	3.38	0.614	1.80	0.075	0.22	0.898	2.64
S	0.997	2.92	0.532	1.56	0.065	0.19	0.778	2.28
M × S	1.994	5.85	1.064	3.12	0.129	0.38	1.556	4.56

Storage methods (M)
M_1 - Sand layer
M_2 - 250 gauge polyethylene bag with 0.5% vents
M_3 - Zero energy cool chamber (ZECC)
M_4 - ZECC + polyethylene bag with 0.5% vents

Seed treatment (S)
S1 - Control
S2 - Ridomil MZ (3 g L^{-1})
S3 - Trichoderma harzianum (5 g kg^{-1} seed rhizome)

number of leaves clump^{-1} (434.3), leaf area index (22.47), number of tillers clump^{-1} (18.2), pseudostem girth (3.14) and fresh rhizome yield (20.54 t ha^{-1}) compared to the lowest in seed rhizome stored under sand layer (36.4 cm, 302.7, 12.67, 14.6, 2.42 cm and 13.37 t ha^{-1}, respectively).

Among the seed rhizome treatments, seed treated with *T. harzianum* produced tallest plants (47.6 cm), higher number of leaves clump^{-1} (399.7), greater leaf area index (20.09), higher number of tillers clump^{-1} (17.3), greater pseudostem girth (3.11 cm) and higher fresh rhizome yield (18.84 t ha^{-1}) compared to the lowest in control without any seed treatment (38.6 cm, 316.9, 14.09, 15.1, 2.54 cm, 15.59 t ha^{-1}, respectively).

The results from the interactions between storage methods and seed rhizome treatments were significant. The treatment combination M_3S_3 (ZECC + *T. harzianum*) recorded higher growth parameters like plant height (52.3 cm), number of leaves clump^{-1} (492.6), leaf area index (25.75), number of tillers clump^{-1} (19.7), pseudostem girth (3.41 cm) and fresh rhizome yield (22.35 t ha^{-1}) compared to the lowest in the treatment combination M_1S_1 (33.6 cm, 252.7, 9.73, 12.6, 2.32 and 11.84 t ha^{-1}, respectively).

The growth and yield of ginger were increased by the use of rhizome stored under ZECC treated with *T. harzianum*, which may be due to the increase in germination of rhizome as reported by earlier workers (Irum-Mukhtar 2008; Windham *et al*. 1986). This also encouraged higher and quicker germination of the crop resulting in optimum vegetative growth with more number of leaves and vigorous growth attributes of clump leading to higher photosynthesis resulting in higher translocation of photosynthates to rhizome which ultimately increased the fresh rhizome yield whereas, the rhizomes stored under sand layer were unhealthy due to desiccation, heavy loss in weight, shriveling and sprouting which ultimately produced inferior plants in the field compared to the healthy and viable rhizomes stored under ZECC.

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