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# Effect of Various Treatments on Seed Rhizome of Turmeric Cv. Salem for Growth, Yield and Quality Attributes

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**ABSTRACT**

*A storage and field experiment was conducted during 2014-15 to study the response of turmeric cv. Salem to pre storage and pre planting seed rhizome treatment. Significantly lowest physiological loss in weight (22.45 %) and shrivelling per cent (2.24 %) was recorded in $T_7$ while the maximum was recorded in $T_8$ (27.06 %) and (10.12 %) respectively. Significantly lowest sprouting per cent (26.22 %) was recorded in $T_7$ while highest (41.08 %) was recorded in $T_8$ during storage under zero energy cool chamber (ZECC). Under field condition results indicated that significantly highest plant height (104.21 cm), number of leaves per plant (18.63), number of tiller per plant (5.89) and leaf area index (5.35) was recorded in $T_7$ and the lowest was recorded in $T_8$ (69.31 cm), (10.61), (2.98) and (4.48) respectively. Significantly maximum yield per plant (592.32 g), yield per plot (18.46 kg) and yield per ha (44.10 t/ha) was recorded in $T_7$ while the minimum in $T_8$ (322.74 g), (9.67 kg) and (23.91 t/ha) respectively. Significantly lowest per cent disease intensity (21.34 %) was recorded in $T_7$ while the highest in $T_8$ (47.43 %). There was no significant difference among the treatments for quality attributes.*

***Key words:*** *Seed rhizome treatment, Salem, Growth, Yield and Quality.*

## INTRODUCTION

Turmeric (*Curcuma longa* L.), a rhizomatous herbaceous plant of the Zingiberaceae family, is usually used as a spice, cosmetic, coloring agent, flavourant and preservative, and also ascribed universally to its aromatic, stimulative and carminative properties. Commercially, it is traded as a spice, dye, oleoresin and source of industrial starch. It is an ancient spice and being used dates back nearly 4000 years to the Vedic culture in India as a culinary spice and dye, and had a wide range of spiritual significance of Hindu religion. Turmeric is valued for its underground rhizome containing a yellow phenolic pigment called curcumin which is used as natural colouring agent for food, cosmetics and dye.

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Curcumin, the main active ingredient of turmeric, functions as a medicine with anti-inflammatory, anti mutagenic, anti-carcinogenic, anti-tumor, anti-bacterial, anti-oxidant, anti-fungal, anti-parasitic and detoxifying properties[16]. India is the largest producer, consumer and exporter of turmeric that accounts about 80%, 90% and 60% share, respectively of the world's total[4]. Turmeric is being largely grown in India, Pakistan, Myanmar, Japan and China. India is the major producer of turmeric, which occupies fifth place in area under spices and ranks second in production next to chillies. It occupies 6.3 per cent of spice area and shares 16.91 per cent of spice production. In India it is being cultivated in more than 20 states in an area of 1,94,000 ha with an annual production of 9,71,000 MT. In India, it is mainly grown in Andhra Pradesh, Orissa, West Bengal, Tamil Nadu, Assam, Maharashtra, Karnataka, Bihar and Kerala. Among these, Andhra Pradesh occupies 34.90 per cent of total area and 43.51 per cent of total production of the country. The national productivity of crop is 5 tons per hectare[2].

Though a lot of trials on varietal, fertilizer, spacing, date of planting, size of planting material, mulching material and irrigation schedule etc. have been conducted to increase the production but very little work has so far been undertaken to increase the production through rhizome treatments using various organic and inorganic sources. Common problems in storage of turmeric are rotting, desiccation and attack of insects. Therefore adopting proper pre-storage treatments will help in minimizing the storage losses of valuable planting material turmeric is planted during May-June[9]. Rhizomes are harvested during December- February under Kerala conditions. therefore, it is inevitable to store the seed rhizomes in healthy and viable condition for 3 to 3½ months before planting. In the cultivation of rhizomatic spices, the costliest input is the- seed rhizome. Nearly 17-20 per cent of the produce is retained for seed purpose and these rhizomes are perishable in nature, susceptible to rotting, sprouting and shrivelling, therefore proper seed rhizome treatment with suitable fungicides and insecticides is necessary to keep them in healthy and viable conditions. . Keeping this in view the present investigation was undertaken to study the effect of seed rhizome treatment on turmeric cv. Salem growth, yield and quality attributes.

## MATERIALS AND METHODS

The field experiment was conducted at K. R. C. College of Horticulture, Arabhavi, Karnataka (India) during the year 2014-15. The trials were laid out in randomized block design (RBD) with three replications using seven different seed rhizome treatments namely **$T_1$**: *Trichoderma viride* (0.4%), **$T_2$**: *Pseudomonas fluorescens* (1%), **$T_3$**: Panchagavya (3%), **$T_4$**: *T. viride* (0.4%) + *P. fluorescens* (1%), **$T_5$**: Captan (0.3%) + Streptocycline sulphate ( 0.03%), $T_6$: Cow dung slurry (10%), $T_7$: Mancozeb 3g/l + Quinalphos 2 ml/l + Streptocycline sulphate 0.3 g/l and $T_8$: Control (No treatment). Uniform healthy rhizome bits of 30-35 g with at least two buds treated with different sources for 30 minutes and shade dried before storage and field planting. Planting was done in first week of June in ridge and furrow method with a spacing of 45 cm x 22.5 cm. The net plot size was 1.8m × 1.35m. The observations on growth yield and quality attributes were recorded at bimonthly intervals and analysis was done.

**Methodology of extraction of quality parameters of turmeric rhizome**

**Volatile oil**

Volatile oil content on fresh weight basis was obtained by steam distillation of freshly harvested rhizome using Clevenger type apparatus adopting standard procedure and expressed in percentage on v/w basis[5].

**Curcumin content**

About 0.1 to 0.2 grams of finely ground turmeric powder was extracted by refluxing over a water cooled condenser with 40 ml of alcohol for 2.5 hours. The extract was made up to 100 ml with alcohol and then filtered and an aliquot of 5 ml was transferred to a 100 ml volumetric flask and made up to volume. It

was mixed well and the absorbance of this solution was measured at 425 nm against alcohol blank using the absorbance value of a standard solution of curcumin (0.00025 g/ml gave an absorbance of 0.42) and the curcumin content was calculated[12].

$$\text{Curcumin content (\% by weight)} = \frac{0.00025 \times \text{absorbance of sample} \times 100 \times 100}{\text{absorbance of standard} \times \text{weight of sample} \times 5}$$

**Non-volatile ether extract (Oleoresin) content**

Pre-weighed finely ground turmeric powder was extracted for 18 h. in soxhlets apparatus with anhydrous petroleum ether. The extract was transferred to a capsule and kept for evaporation at room temperature. Then it was dried in hot air oven at $110^0$ C till the loss in weight between successive weighing was less than two mg. The amount of non volatile ether extract was computed by using the formula given below[3].

**Methodology of Per cent disease intensity (PDI)**

Intensity of *Alternaria* leaf spot incidence was recorded under natural disease pressure conditions at different stages of crop growth (30, 90, 150 and 180 DAP). The disease scoring was done using the 1 to 5 scale.

| Scale | Score/PDI |
|---|---|
| 0 | Leaves free from infection |
| 1 | 1-5 per cent leaf area affected |
| 2 | 6 -20 per cent leaf area affected |
| 3 | 21-40 per cent leaf area affected |
| 4 | 41-70 per cent leaf area affected |
| 5 | 71 per cent and above leaf area affected |

**Methodology of Physiological loss in weight (PLW)**

Initially 5 kilograms of rhizomes randomly selected in each treatment and these rhizomes were used each time for recording PLW. The weight of rhizome was recorded on 30, 60 and 90 days after storage using electronic balance. The cumulative loss in weight of rhizomes was calculated and expressed as per cent physiological loss in weight using the formula given below:

$$\text{PLW (\%)} = \frac{P_O - (P_1 \text{ or } P_2 \text{ or } P_3)}{Po} \times 100$$

Where, $P_0$: Initial weight $P_1$: Weight after 30 DAS

$P_2$: Weight after 60 DAS $P_3$: Weight after 90 DAS

## RESULTS AND DISCUSSION

The data presented in table 1- 5 clearly revealed that growth, yield and quality attributes were significantly influenced by seed rhizome treatments. Physiological loss in weight varied significantly among seed rhizome treatments. The minimum physiological loss in weight was recorded in $T_7$ (22.45 %) which was on par with $T_5$ (22.85 %), $T_4$ (23.15 %) $T_1$ (24.42 %), $T_2$ (24.96 %) and $T_3$ (25.46 %), while maximum was recorded in $T_8$ (27.06 %). The similar observations were reported and are in conformity with earlier workers. Kirankumar *et al*[10]., recorded maximum PLW in untreated control (24.47 %) while the minimum was recorded in captan plus monocrotophos combination (19.18 %). The minimum shrivelling per cent was recorded in $T_7$ (2.24 %) followed by $T_4$ (3.38 %) while the

maximum was recorded in $T_8$ (10.12 %). The minimum sprouting per cent was recorded in $T_7$ (26.22 %) which was on par with $T_5$ (29.16 %) while maximum was recorded in $T_8$ (41.08 %). Results are in conformity with Ammon and Wahl[1] (1991) who reported that by inhibiting sprouting of turmeric rhizomes, it is possible to increase the self life and quality of turmeric rhizomes.

The maximum plant height was recorded in $T_7$ (104.21 cm) which was followed by $T_5$ (94.23 cm) while the minimum was recorded in $T_8$ (69.31 cm). The maximum number of leaves per plant was recorded in $T_7$ (18.63) followed by $T_5$ (15.93). The minimum was recorded in $T_8$ (10.61). The maximum number of tillers per plant was recorded in $T_7$ (5.89) followed by $T_5$ (5.09). The maximum leaf area per plant was recorded in $T_7$ (54.18 $dm^2$) which was on par with by $T_5$ (52.63 $dm^2$), $T_4$ (51.83 $dm^2$), $T_1$ (49.16 $dm^2$), $T_2$ (49.03 $dm^2$) and $T_3$ (48.94 $dm^2$), The minimum was recorded in $T_8$ (45.40 $dm^2$). The maximum leaf area index (LAI) was recorded in $T_7$ (5.35) which was $T_5$ (5.20), $T_4$ (5.12), $T_1$ (4.86), $T_2$ (4.84) and $T_3$ (4.83), while the minimum was recorded in $T_8$ (4.48). The maximum pseudostem girth was recorded in $T_7$ (6.28 cm) followed by $T_5$ (6.02 cm) and minimum was recorded in $T_8$ (5.34 cm) at 180 DAP. Similar results were also reported by Mohanty and Sharma[13]; Sharma *et al*[15].,; Hore *et al*[8]., and Naresh *et al*[14].

The maximum number of primary rhizomes was recorded in $T_7$ (8.66) which was on par with $T_5$ (7.81), while the minimum was recorded in $T_8$ (4.03). The maximum number of secondary rhizomes was recorded in $T_7$ (14.87) which was on par with $T_5$ (13.32), $T_4$ (13.04), $T_1$ (12.98), while the minimum was recorded in $T_8$ (9.63). The maximum length of mother rhizome was recorded in $T_7$ (5.27 cm) and $T_5$ (5.27 cm) which was on par with $T_2$ (5.22 cm), $T_4$ (5.19 cm), $T_1$ (5.16 cm), $T_3$ (5.08 cm) and $T_6$ (4.67 cm).The minimum was recorded in $T_8$ (4.04 cm). The maximum length of primary rhizome was recorded in $T_7$ (6.92 cm) which was on par with $T_5$ (6.83 cm) and $T_4$ (6.59 cm), while the minimum was recorded in $T_8$ (4.96 cm). The maximum length of secondary rhizome was recorded in $T_7$ (5.83 cm) followed by $T_5$ (5.52 cm) while the minimum was recorded in$T_8$ (4.86 cm). Similar variations in these characters among the seed rhizome treatment were reported by earlier workers in turmeric. The maximum girth of mother rhizome was recorded in $T_7$ (3.18 cm) which was on par with $T_5$ (3.05 cm), $T_4$ (3.01 cm), $T_1$ (2.89 cm), $T_2$ (2.85 cm) and $T_3$ (2.77 cm). The minimum was recorded in$T_8$ (2.18 cm). The maximum girth of primary rhizome was recorded in $T_7$ (2.18 cm) followed by $T_5$ (2.13 cm).The minimum was recorded in $T_8$ (2.01 cm). The maximum girth of secondary rhizome was recorded in $T_7$ (1.79 cm) followed by $T_5$ (1.71 cm). The minimum was recorded in$T_8$ (1.55).

The maximum fresh weight of mother rhizome was recorded in $T_7$ (62.92 g) which was on par with $T_5$ (58.92 g), $T_4$ (58.01 g) and $T_1$ (56.94 g) while the minimum was recorded in $T_8$ (49.41 g). The maximum fresh weight of primary rhizome was recorded in $T_7$ (311.58 g) which was on par with $T_5$ (298.62 g). The minimum was recorded in $T_8$ (172.10 g). The maximum fresh weight of secondary rhizome was recorded in $T_7$ (227.49 g) followed by $T_5$ (201.43 g). Compared to minimum was recorded in $T_8$ (101.23 g). The maximum yield per plant was recorded in $T_7$ (595.32 g) followed by $T_5$ (558.97 g) while the minimum was recorded in $T_8$ (322.74 g). The maximum estimated fresh yield per ha was recorded in $T_7$ (44.10 t/ha) followed by $T_5$ (41.41 t/ha) while the minimum was recorded in $T_8$ (23.91 t/ha). Similar variations in these characters among the seed rhizome treatment were reported by earlier workers in turmeric. Hore *et al*[8]., reported that rhizomes treated with $KHPO_2$ 0.5 per cent produced significantly higher clump weight (346.28 g), yield per plot (14. 97 kg/ $3m^2$) and projected yield (34. 37 t/ha) as compared to control (258.34g, 10.62 kg/ $3m^2$ and 26.55 t /ha, respectively).

The yield and quality of turmeric after seed rhizome treatments appears to enhance microbial activities in the soil and improved nutritional status in the root zone as well as in

the plant system. Similar results were also reported by Mohanty and Sharma[13], Sharma *et al*[15]., Kusum *et al*[11]., Hore *et al*[8]., and Naresh *et al*[14].

The minimum per cent disease intensity (PDI) was recorded in $T_7$ (21.34 %) followed by $T_5$ (30.51 %). The maximum was recorded in $T_8$ (47.43 %). Similar results were also reported by Dohroo *et al*[7]., and Chowdary *et al*[6]. Crop duration varied significantly among seed rhizome treatments. The treatment $T_7$ took higher number days for maturation (242 days) which was on par with $T_5$ (235 days) and $T_4$ (234 days) while $T_8$ took lower number days for maturation (221 days). Higher the intensity of PDI, lower was the duration of crop due to senescence and drying of leaves as well before actual maturity.

Maximum recovery of healthy rhizomes due to minimum incidence of PLW, shriveling percentage and sprouting percentage of seed rhizomes in $T_7$ (Mancozeb 3g/l + Quinalphos2 ml/l + Streptocycline sulphate 0.3 g/l ) treatment must have contributed for the better growth and yield performance in these treatments even in the field. Similar variations in these characters among the seed rhizome treatment were reported by earlier workers in turmeric. The yield and quality of turmeric after seed rhizome treatments appears to enhance microbial activities in the soil and improved nutritional status in the root zone as well as in the plant system. Similar results were also reported by Mohanty and Sharma[13], Sharma *et al*[15]., Hore *et al*[8]., and Naresh *et al*[14].

**Table 1: Effect of seed rhizome treatment on physiological loss in weight (PLW), shriveling percentage and sprouting percentage of seed rhizomes in turmeric cv. Salem at 90 days after storage (DAS)**

| Seed rhizome treatment | PLW (%) | Shriveling (%) | Sprouting (%) |
|---|---|---|---|
| **$T_1$**:*Trichoderma viride*( 0.4%) | 24.42 | 4.59 | 34.56 |
| **$T_2$**: *Pseudomonas fluorescens* (1%) | 24.96 | 4.08 | 32.12 |
| **$T_3$**: Panchagavya 3 per cent | 25.46 | 4.13 | 38.13 |
| **$T_4$**: *T.viride* ( 0.4%) + *P. fluorescens* (1%) | 23.15 | 3.38 | 31.48 |
| **$T_5$**: captan 0.3% + Streptocycline sulphate 0.03% | 22.85 | 3.56 | 29.26 |
| **$T_6$**: Cow dung slurry (10%) | 26.26 | 6.36 | 39.88 |
| **$T_7$**: Mancozeb 3g/l + Quinalphos2 ml/l + Streptocycline sulphate 0.3 g/l | 22.45 | 2.24 | 26.22 |
| **$T_8$**: Control (No treatment) | 27.06 | 10.12 | 41.08 |
| **S. Em±** | 0.72 | 0.12 | 1.11 |
| **C. D. at 1%** | 3.03 | 0.51 | 4.68 |
| **CV (%)** | 5.07 | 4.59 | 5.65 |

**Table 2: Effect of seed rhizome treatment on growth parameters in turmeric cv. Salem at 180 DAP**

| Treatment | Plant height (cm) | Number of leaves per plant | Number of tillers per plant | Leaf area ($dm^2$) | Leaf area index (LAI) | Pseudostem girth (cm) |
|---|---|---|---|---|---|---|
| $T_1$ | 80.46 | 12.62 | 4.23 | 49.16 | 4.86 | 5.90 |
| $T_2$ | 79.93 | 13.13 | 4.18 | 49.03 | 4.84 | 5.87 |
| $T_3$ | 76.43 | 11.62 | 4.02 | 48.94 | 4.83 | 5.79 |
| $T_4$ | 89.36 | 13.22 | 4.94 | 51.83 | 5.12 | 5.98 |
| $T_5$ | 94.23 | 15.93 | 5.09 | 52.63 | 5.20 | 6.02 |
| $T_6$ | 73.49 | 11.08 | 3.19 | 46.23 | 4.57 | 5.69 |
| $T_7$ | 104.21 | 18.63 | 5.89 | 54.18 | 5.35 | 6.28 |
| $T_8$ | 69.31 | 10.61 | 2.98 | 45.40 | 4.48 | 5.34 |
| **S. Em±** | 2.04 | 0.61 | 0.06 | 1.32 | 0.20 | 0.30 |
| **C. D. at 5%** | 6.18 | 1.86 | 0.18 | 5.30 | 0.61 | NS |
| **CV (%)** | 10.23 | 7.94 | 11.43 | 8.60 | 7.14 | 8.93 |

NS= Non significant

**Table 3: Effect of seed rhizome treatment on yield and yield attributes in turmeric cv. Salem at 180 DAP**

| Treatment | Primary rhizomes (No/ plant) | Secondary rhizomes (No/ plant) | Length (cm) | | | Girth (cm) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Mother rhizome | Primary rhizome | Secondary rhizome | Mother rhizome | Primary rhizome | Secondary rhizome |
| $T_1$ | 7.09 | 12.98 | 5.16 | 6.13 | 5.20 | 2.89 | 2.04 | 1.63 |
| $T_2$ | 6.98 | 12.72 | 5.22 | 6.02 | 5.14 | 2.85 | 2.06 | 1.65 |
| $T_3$ | 6.43 | 11.95 | 5.08 | 5.96 | 5.09 | 2.77 | 2.03 | 1.63 |
| $T_4$ | 7.18 | 13.04 | 5.19 | 6.59 | 5.43 | 3.01 | 2.08 | 1.68 |
| $T_5$ | 7.87 | 13.32 | 5.27 | 6.83 | 5.52 | 3.05 | 2.13 | 1.71 |
| $T_6$ | 6.13 | 11.81 | 4.67 | 5.81 | 5.10 | 2.36 | 2.04 | 1.60 |
| $T_7$ | 8.66 | 14.87 | 5.27 | 6.92 | 5.53 | 3.18 | 2.18 | 1.79 |
| $T_8$ | 4.03 | 9.63 | 4.04 | 4.96 | 4.86 | 2.18 | 2.01 | 1.55 |
| **S. Em±** | 0.62 | 0.68 | 0.21 | 0.26 | 0.20 | 0.23 | 0.18 | 0.07 |
| **C. D. at 5%** | 1.88 | 2.05 | 0.65 | 0.78 | NS | 0.69 | NS | NS |
| **CV (%)** | 15.77 | 9.33 | 7.43 | 7.28 | 6.50 | 14.16 | 15.04 | 12.80 |

NS= Non significant

**Table 4: Effect of seed rhizome treatment on yield and quality attributes in turmeric cv. Salem at 180 DAP**

| Treatment | Fresh weight (g/plant) | | | Fresh rhizome yield | | | Essential oil (%) | Oleoresin (%) | Curcumin (%) |
|---|---|---|---|---|---|---|---|---|---|
| | Mother rhizome | Primary rhizome | Secondary rhizome | (g/ plant) | (kg/plot/4.86m$^2$) | Estimated (t /ha) | | | |
| $T_1$ | 56.94 | 260.46 | 172.43 | 489.83 | 15.18 | 36.28 | 4.46 | 12.78 | 4.07 |
| $T_2$ | 55.48 | 255.33 | 170.93 | 481.74 | 14.93 | 35.68 | 4.45 | 12.78 | 4.06 |
| $T_3$ | 55.09 | 229.12 | 157.69 | 441.90 | 13.70 | 32.73 | 4.45 | 12.76 | 4.04 |
| $T_4$ | 58.01 | 268.33 | 189.67 | 516.01 | 15.67 | 38.22 | 4.48 | 12.79 | 4.07 |
| $T_5$ | 58.92 | 298.62 | 201.43 | 558.97 | 17.33 | 41.41 | 4.48 | 12.28 | 4.08 |
| $T_6$ | 52.06 | 206.63 | 123.36 | 382.05 | 11.84 | 28.30 | 4.43 | 12.76 | 4.04 |
| $T_7$ | 62.92 | 311.58 | 227.49 | 595.32 | 18.46 | 44.10 | 4.50 | 12.80 | 4.08 |
| $T_8$ | 49.41 | 172.10 | 101.23 | 322.74 | 9.67 | 23.91 | 4.43 | 12.75 | 4.04 |
| **S. Em±** | 2.01 | 4.61 | 4.04 | 6.56 | 0.41 | 0.62 | 0.20 | 0.51 | 0.20 |
| **C. D. at 5%** | 6.11 | 14.00 | 12.26 | 19.90 | 1.24 | 2.87 | NS | NS | NS |
| **CV (%)** | 7.22 | 8.19 | 8.17 | 12.40 | 9.84 | 8.23 | 7.93 | 6.97 | 8.71 |

NS= Non significant

**Table 5: Effect of seed rhizome treatment on per cent disease intensity (PDI) for *Alternaria* leaf spot at 180 DAP and crop duration (days) in turmeric cv. Salem**

| Seed rhizome treatment | PDI for *Alternaria* leaf spot | Crop duration (days) |
|---|---|---|
| $T_1$:*Trichoderma viride* (0.4%) | 35.68 | 230.00 |
| $T_2$: *Pseudomonas fluorescens* (1%) | 36.92 | 232.00 |
| $T_3$: Panchagavya 3 per cent | 38.29 | 226.00 |
| $T_4$: *T.viride* (0.4%) + *P. fluorescens* (1%) | 34.18 | 234.00 |
| $T_5$: captan 0.3% + Streptocycline sulphate 0.03% | 30.51 | 235.00 |
| $T_6$ : Cow dung slurry (10%) | 43.69 | 225.00 |
| $T_7$: POP recommendations (mancozeb 3g/l + quinalphos 2 ml/l ) | 21.34 | 242.00 |
| $T_8$: Control (No treatment) | 47.43 | 221.00 |
| S. Em± | 1.50 | 2.78 |
| C. D. at 5% | 4.56 | 8.45 |
| CV (%) | 7.23 | 12.09 |

DAP= Days after planting

## CONCLUSION

I. Turmeric genotypes Salem and Suroma are found to be suitable for cultivation under irrigated conditions of northern dry zone of Karnataka to get higher yield and quality rhizomes.

II. Seed rhizome treatment before storage and before planting with mancozeb at 3g/l + quinalphos at 2 ml/l were found to be effective in getting higher recovery of healthy rhizomes.

III. For organic cultivation of turmeric, recovery of higher per cent of healthy seed rhizomes may be had with the use of biological agents like, *Trichoderma viride* at 0.4 per cent per kg of rhizomes and *Pseudomonas fluorescens* at 1 per cent per kg of rhizomes in combination.

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