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# Standardization of integrated disease management schedule for rhizome rot of *ekangi*

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## Abstract

**A field experiment was conducted during 2020- 21 in Dhaanyaganga Krishi Vigyan Kendra's own field and farmers field on standardization of integrated disease management schedule for rhizome rot of ekangi. The experiment was laid out in RBD with seven treatment combinations in stage of cultural operation i.e., land preparation with or without organic manure and bio-inoculants, seed treatments with both chemical and organic means followed by different combination of spraying or soil drenching. It was found that land preparation with FYM, neem cake and *Trichoderma viridi* along with rhizome treatment with metalaxyl 35% WS followed by alternate spray with Metalaxyl 8% + Mancozeb 64% WP @ 2.5 g/litre of water and Fenamidone 10% + Mancozeb 50% WG @ 2.5 g/litre of water followed by for spraying at root zone after initial symptom development was found to be most effective in new alluvial zone of West Bengal.**

**Keywords:** ***Disease management; Rhizome rot; Ekangi***

## 1. Introduction

Ekangi (*Kaempferia galanga* L.) is an important medicinal and aromatic plant. It belongs to Zingiberaceae family. It is commonly known as Cekor, Kencur or aromatic ginger. It is still considered as unutilized herbs in spite of having different pharmacological properties like antioxidant, antimicrobial, analgesic, anti-inflammatory, sedative, mosquito repellent and wound healing activities. The most vital phyto-constituent isolated from ekangi extracts found Ethyl-cinnamate and Ethyl-p-methoxycinnamate. India is endowed with rich diversity of plant wealth since 5000 BC. The Historical Murshidabad district of West Bengal which is also popularly known as "Crop Museum" due to its wide diversity in cropping, has a treasure of

cultivation of *Ekangi* (*Kaempferia galanga* L.) with a coverage of more than 5000 ha. The blocks like Domkal, Jalangi, Raninagar-II, Raninagar-I and Beldanga-I etc. contribute maximum acerage of *ekangi*. Mostly small and marginal farmers use to cultivate *ekangi*. They are suffering from quality planting material, lack of standardize production technique and the infestation of rhizome rot. The crop fetches high market price even in local market but the main bottleneck of the cultivation of *ekangi* is entire crop failure due to infestation of rhizome rot. Several chemical pesticides like Mancozeb 0.25%, Carbendazim 0.1%, Ridomil MZ (0.2%), Topsin M (0.2%) [1], botanicals like neem, garlic, agave, onion lantana, walnut, soap nut etc. [2,3] as well as biological agents like Trichoderma spp., Jeevatu, etc. has been tested and used in field level for the rhizome rot of ginger [4]. More than 25000 farm families are dependent on the production system but till date no effort has been made to extend research-based extension support for the stakeholders. The work on this aspect is very little and no comprehensive recommendation is available to the farmer's end.

## 2. Materials and Methods

The present study was carried out in farmers' field as well as KVK's own farm to identify the causal organism and find out the suitable integrated disease management schedule for the *ekangi* growers. The experiment was planned with seven treatment combination in Randomized Block Design (RBD) during 2020-21 with three replications. The treatment combination was aimed to interfere in three field operations i.e., seed treatment, pre-planting soil treatment and soil drenching/ foliar spray. In case of seed treatment both biological (*Trichoderma viridi*, *Trichoderma harzenium* and *Psedudomonas fluroscence*) and chemical (Metalaxyl @ 35% WS, Mancozeb 72% WP) were taken into consideration. Organic manure like neem cake, Farm Yard Manure along with bio-inoculants like *T. viridi*, *T. harzenium* and *P. fluroscence* in different combination were evaluated. On the other hand, soil drenching with above mentioned bio-inoculants or foliar spray with Metalaxyl 8% + Mancozeb 64%and Fenamidone 10% + Mancozeb 50% WG were tested for suitability.

Local *ekangi* variety was used and planted on 1st March, 2020. The experimental plot size was 2 x 2 $m^2$. Row to row distance was 50 cm and rhizome to rhizome distance was 25 cm. Each plot had four rows and in each row eight healthy seed rhizomes were planted. Apparently healthy rhizomes were treated with bio fungicide and fungicide according to treatment before sowing. Rhizomes were dipped in solution of Mancozeb or Metalaxyl or *T. harzenium* or *T. viridi* for 30 min and then dried in shade and planted in the field. Soil drenching was started 60 days after planting at the time of diseases initiation and successive soil drenching was applied 6 times at 30 days interval (TABLE 1).

TABLE 1. **Treatment details.**

| Treatment | Details |
|---|---|
| **$T_1$** | Seed treatment Mancozeb 75% WP @ 2.5 g/litre followed by alternate rotation of Metalaxyl 8% + Mancozeb 64% @ 2.5 g/ litre of water and Fenamidone 10% + Mancozeb 50% WG @ 2.5 g/ litre of water for spraying at root zone after initial symptom development |
| **$T_2$** | Seed treatment with Metalaxyl 35% WS @ 0.5 g/ litre followed by rotation of Metalaxyl 8% + Mancozeb 64% WP @ 2.5 g/ litre of water for spraying at root zone after initial symptom development |

| | |
|---|---|
| **$T_3$** | Soil application of neem cake @ 250 kg/ ha + FYM @ 10 t/ha + *T. harzenium* @ 1.5 kg/ ha + seed treatment with *T. harzenium* @ 4-5 g/ kg of seed followed by soil drenching with *T. harzenium* |
| **$T_4$** | Soil application of Application of neem cake @ 250 kg/ ha + FYM @ 10 t/ha + *T. viridi* @ 1.5 kg/ ha + seed treatment with *T. viridi* @ 4-5 g/kg of seed followed by soil drenching with *T. viridi* |
| **$T_5$** | Soil application of neem cake @ 250 kg/ ha + FYM @ 10 t/ha + *P. fluroscence* @ 1.5 kg/ ha + Seed treatment with *P. fluroscence* @ 4-5 g/kg of seed followed by soil drenching with *P. fluroscence* |
| **$T_6$** | Application of neem cake @ 250 kg/ ha + FYM @ 10 t/ha + *T. viridi* @ 1.5 kg/ ha + seed treatment with Metalaxyl 35% WS @ 0.5 g/ litre followed by alternate rotation of Metalaxyl 8% + Mancozeb 64% WP @ 2.5 g/ litre of water and Fenamidone 10% + Mancozeb 50% WG @ 2.5 g/ litre of water for spraying at root zone after initial symptom development |
| **$T_7$** | Application of neem cake @ 250 kg/ ha + FYM @ 10 t/ha + *T. viridi* @ 1.5 kg/ ha + seed treatment with Metalaxyl 35% WS @ 0.5 g/ litre followed by rotation of Metalaxyl 8% + Mancozeb 64% WP @ 2.5 g/ litre of water at root zone after initial symptom development |

Data on germinations percentage, number of tillers per plant, plant infection percentage, disease severity (0-5 scale) yield were recorded. The crop was harvested in first week of January, 2020. Total weight of fresh rhizome harvested from each plot in each replication was recorded and it was converted per hectares under different treatments computed in kilogram per hectare. The result so obtained was subjected to statistical analysis by analysis of variance method. The significance of difference sources of variation was tested by Fischer and Snedecor's 'F' test at probability level 0.05.

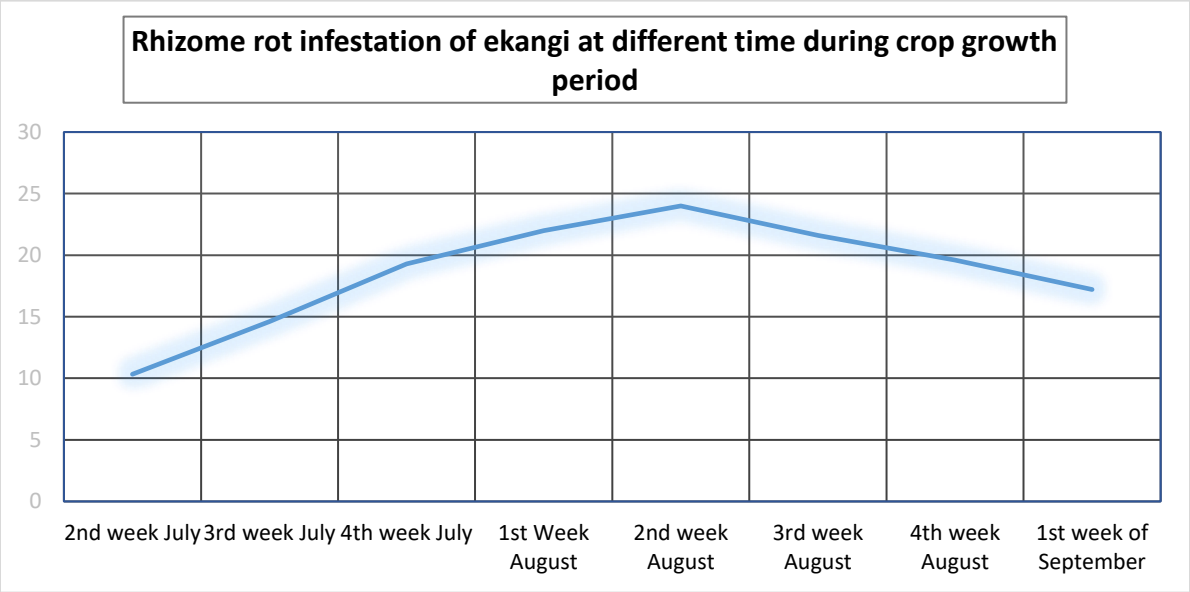
## 3. Results and Discussion

The germination percentage and numbers of tiller per plant was enhanced when soil ameliorants/ organic manure along with bio-inoculants were applied during land preparation. It was also recorded that all these treatments had statistically at par influence on germination. Moreover, the maximum improvement in rhizome germination (94%) was recorded in Treatment $T_7$. Again, the maximum number of tillers per plant (15.7) was recorded when the plant received soil application of neem cake @ 250 kg/ha + FYM @ 10 t/ha + *T. viridi* @ 1.5 kg/ha + seed treatment with Metalaxyl 35% WS @ 0.5 g/litre followed by alternate rotation of Metalaxyl 8% + Mancozeb 64% WP @ 2.5 g/litre of water and Fenamidone 10% + Mancozeb 50% WG @ 2.5 g/litre of water for spraying at root zone after initial symptom development. Both the organically treated plots of *Trichoderma spp* produce statistically at par tillers per plant. The lowest germination percentage (84%) and number tillers per plant (10.3) was recorded when the rhizome was treated with Mancozeb 75% WP @ 2.5 g/litre followed by alternate rotation of Metalaxyl 8% + Mancozeb 64% @ 2.5 g/litre of water and Fenamidone 10% + Mancozeb 50% WG @ 2.5 g/litre of water for spraying at root zone after initial symptom development (TABLE 2).

TABLE 2. **Effectiveness of organic manure/ soil ameliorants, bio-inoculants and fungicides against rhizome rot of *ekangi* in Murshidabad district of West Bengal.**

| Treatment | Rhizome germination | Nos. of tiller/plant | Plant infected (%) | Disease severity (0-5) scale | Yield (t/ha) |
|---|---|---|---|---|---|
| $T_1$ | 84% | 10.3 | 20.75 | 3 | 11.83 |
| $T_2$ | 86% | 10.7 | 23.83 | 4 | 10.77 |
| $T_3$ | 93% | 14.3 | 19.33 | 2 | 12.57 |
| $T_4$ | 92% | 14.7 | 19.0 | 2 | 12.33 |
| $T_5$ | 90% | 12.8 | 21.3 | 3 | 11.53 |
| $T_6$ | 94% | 15.7 | 15.33 | 1 | 14.83 |
| $T_7$ | 93% | 15.3 | 17.47 | 1 | 13.73 |
| S.Em (±) | 1.08 | 0.10 | 0.25 | - | 0.21 |
| CD at 5% | 3.28 | 0.31 | 0.72 | - | 0.64 |

Moreover, it was clearly noticed that the disease infestation was started from 2nd week of July and reached peak during 3rd week of August when the soil moisture and atmospheric humidity was high along with higher ambient temperature. Gradually the infestation lowered, and it was below the economic threshold from the 1st week of September.




The minimum of 15.33% infected plants were noticed with application of neem cake @ 250 kg/ha + FYM @ 10 t/ha + *T. viridi* @ 1.5 kg/ ha + seed treatment with Metalaxyl 35% WS @ 0.5 g/litre followed by alternate rotation of Metalaxyl 8% + Mancozeb 64% WP @ 2.5 g/litre of water and Fenamidone 10% + Mancozeb 50% WG @ 2.5 g/litre of water for spraying at root zone after initial symptom development which was followed by the 17.47% in Treatment $T_7$ (application of neem cake @ 250 kg/ha + FYM @ 10 t/ha + *T. viridi* @ 1.5 kg/ha + seed treatment with Metalaxyl 35% WS @ 0.5 g/litre followed by rotation of Metalaxyl 8% + Mancozeb 64% WP @ 2.5 g/litre of water at root zone after initial symptom development). In both these treatments disease severity were minimum. The disease occurrence as well as severity was higher when the treatment

received seed treatment with Metalaxyl 35% WS @ 0.5 g/litre followed by rotation of Metalaxyl 8% + Mancozeb 64% WP @ 2.5 g/litre of water for spraying at root zone after initial symptom development. The efficacy of combinations of systemic and contact fungicides Fenamidone 10% + Mancozeb 50% WG in alternation was also observed by Kumar *et al* [5]. Among five fungicides evaluated in in vitro condition against *A. solani*, Fenamidone 10% + Mancozeb 50% (sectin) gave the maximum inhibition (83.79%) of mycelial growth.

The highest rhizome yield (14.83 t/ha) was registered when the rhizome was treated with Metalaxyl 35% WS @ 0.5 g/litre of water and pre plant soil application of neem cake 250 kg/ha + FYM 10 t/ha along with *T. viridi* @ 1.5 kg/ha. In later stage of growth, the crop was sprayed at root zone with Metalaxyl 8% + Mancozeb 64% @ 2.5 g/ litre of water followed by Fenamidone 10% + Mancozeb 50% WG @ 2.5 g/litre of water after initial symptom development in alternate rotation. The improvement in rhizome yield may be due to the fact that presence of FYM and nee cake along with *T. viridi* showed better germination, root proliferation, better crop establishment. The seed treatment with metalaxyl resulted prevention against early disease infestation. On the other hand, need based application of Fenamidone 10% + Mancozeb 50% WG was giving dual contact and systemic activity against Phycomycetes diseases, pythium as well as non-phycomycetes diseases too some extent with protective action. The result is corroborated with the findings of Ayub et al [6]. When the crop was managed in totally with organic means, it showed better performance up to July or 1$^{st}$ week of August (120 to 140 DAP), in later stage of crop growth infestation of disease occurred which in turn resulted comparatively lower yield than integrated management schedule. Rhizome treatment with both the species of *Trichoderma* with soil application along with organic manure though is eco-friendly management practice, it gave average fresh rhizome production in both experiments (12.57 and 12.53 t/ha, respectively). The results are in line with the findings of Acharya and Regmi [7]. Similarly, Dohroo [2] also reported that biological control of Pythium soft rot disease is very difficult task because of rapid germination of sporangia in response to rhizome or root exudates followed by immediate secondary infection during rainy season and ability to cause subsequent progress in infection leading to further long-term rhizome and root rot in ginger.

## 4. Conclusion

Though the pathogen was not clearly identified in the first year of experimentation, but from the symptoms and efficacy of the disease management means, it might be Pythium group of fungus. It may also be inferred from the present investigation that for efficient management of rhizome rot disease of ekangi soil ameliorant FYM and neem cake should be used during final land preparation in conjunction with inoculation of *T. viridi*. Seed treatment by Metalaxyl 35% WS is also to be practiced along with alternate rotation of spray with Metalaxyl 8% + Mancozeb 64% WP @ 2.5 g/litre of water and Fenamidone 10% + Mancozeb 50% WG @ 2.5 g/litre of water for spraying at root zone after initial symptom development.

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