

# 琉球大学学術リポジトリ

## 万田31号施用が台風後のウコン(*Curcuma spp.*)の被害回復,生育および収量におよぼす効果

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# Damage Recovery, Growth and Yield of Turmeric (*Curcuma* spp.) Plant with Manda 31 Application after Typhoon Occurrence

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**Abstract:** Manda 31 is a fermented natural plant concentrate, which improves yield and quality of crops, vegetables and fruits without any hazard of environment factors. A series of experiments was conducted at the Subtropical Field Science Center of the University of the Ryukyus in 1999-2000, actually to examine the efficacy of manda 31 on growth and yield of turmeric. Manda 31 at 100ppm was applied 10 times to leaf, soil or leaf and soil at a 15-day interval until November. A strong typhoon, occurred on September 22, 1999, caused severe damages of turmeric plants in all fields equally. It was unbelievable that there were some differences in damage recovery and growth of turmeric plants between manda 31 applied field and commercial field (Manda 31 not applied), after typhoon occurred. Hence, in this paper, we compared damage recovery, growth and yield of turmeric between manda 31 applied field and commercial field. New tillers and leaves of turmeric plants developed within 15 days of typhoon occurred in the manda 31 applied field, and continued the process up to November. Around 70% of damaged plants recovered due to continuous application of manda 31, and the plants remained green up to December. It was also unbelievable that the plants in some rows in commercial field, which were adjacent to the manda 31 applied field (up to 18 m from manda 31 applied field), produced some new tillers and leaves, and remained green until November. On the other hand, the plants in this field, which were greater than 18 m from manda 31 applied field, withered within 40 days of typhoon occurred. Turmeric yield was around three times higher in manda 31 treated field than that in commercial field. Yield in the first four rows (4-11 m from manda 31 treated field) of commercial field was significantly higher than that in far rows (>11 m). Effect of manda 31 was not observed on plants in rows with greater than 18 m from manda 31 applied field. These results indicate that the manda 31 is effective in stress condition of plant, and plants in neighboring field of manda 31 applied field may be benefited with manda 31. It was assumed that manda 31 moved with heavy rainfall to the neighboring field.

**Key words:** damage recovery, fermented natural plant concentrate (manda 31), movement of manda 31 activities, turmeric (*Curcuma* spp.) yield

## Introduction

Manda 31 is a fermented natural plant concentrate, which improves yield and quality of crops, vegetables and fruits without any hazard of environment factors.<sup>1-6)</sup> Manda 31 is produced from 50 natural plant materials through some high technologies applied for more than three years. Manda 31 contains glycine, alanine, serine, praline, valine, threonine, isoleucine, lysine, leucine, glutamine, methionine, histidine, phenylalanine, arginine, tryptophane, asparagine, cystine and tyrosine. It was reported that these components somehow promote germina-

tion, growth, yield and quality of plants.<sup>1-4)</sup>

A many of farmers reported that manda 31 is very effective in stress condition of plants. The extension team of the Manda Fermentation Co. Ltd. reported that Manda 31 promoted root growth of tomato plant in stress condition caused by typhoon occurrence in South Korea. It was also reported that plants in neighboring field of manda 31 applied fields were benefited, and no yield difference was observed between manda 31 applied field and neighboring field (manda 31 not applied) (personal communication, extension researchers, Manda Hakko).

A series of experiments was conducted at the

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Fig. 1. Damage of turmeric plants caused by typhoon occurred on September 22, 1999. Photo was snapped 2 days after typhoon occurred.

- A: Manada 31 applied field of *Curcuma longa* L. (Aki ukon).  
 B: Commercial field of *Curcuma longa* L. (Aki ukon).  
 C: Commercial field of *Curcuma aromatica* SALISB. (Haru ukon).

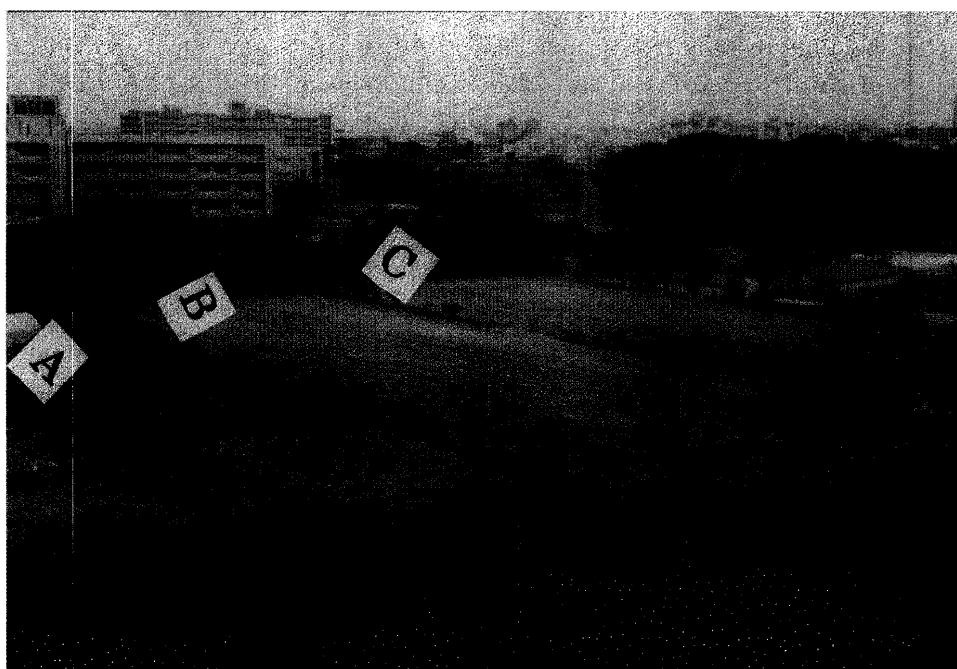


Fig. 2. Damage recovery of turmeric plants in manda 31 applied field and commercial field. Manda 31 at 100ppm was applied at different intervals for different experiments, until November 1999. Photo was snapped 65 days after typhoon occurred.

- A: Manada 31 applied field of *Curcuma longa* L. (Aki ukon).  
 B: Commercial field of *Curcuma longa* L. (Aki ukon).  
 C: Commercial field of *Curcuma aromatica* SALISB. (Haru ukon).

Subtropical Field Science Center of the University of the Ryukyus in 1999-2000 to examine the efficacy of manda 31 on turmeric (*Curcuma* spp.) plant (turmeric is an important medicinal plant having antioxidant properties and protective powers, and it is also used as spices and cosmetic<sup>1)</sup>). Manda 31 at 100ppm was applied to leaf, soil or leaf and soil at

different intervals depending on different experimental designs. A strong typhoon, occurred on September 22, 1999, caused severe damages of turmeric plants in all the fields. It was unbelievable that there were some differences in damage recovery and growth of turmeric plants between manda applied field and commercial field after

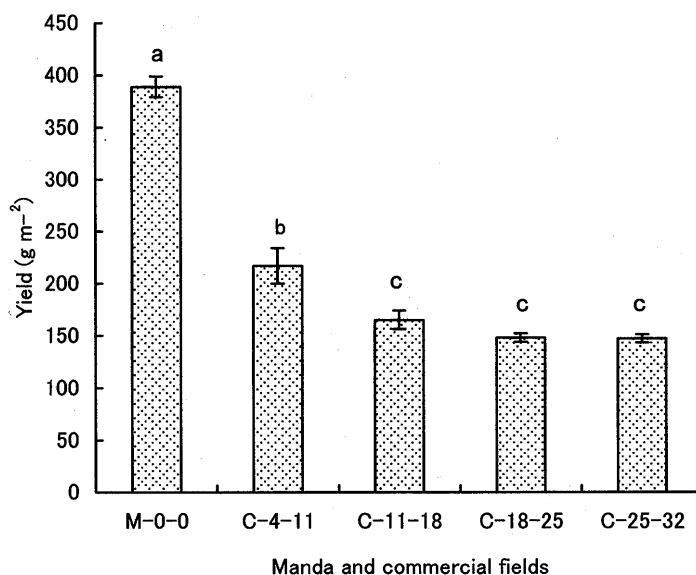


Fig. 3. Turmeric yield in manda 31 treated field and commercial fields with different distances from the manda 31 treated field. M-0-0: Manda 31 treated field; C-4-11: Commercial field with 4-11 m distance; C-11-18: Commercial field with 11-18 m distance; C-18-25: Commercial field with 18-25 m distance, and C-25-32: Commercial field with 25-32 m distance. Data are means  $\pm$ SD of 4 replications. Bars with the same letter are not significantly different at 5% level, as determined by Fisher's Protected LSD test.

typhoon occurred. Hence, in this paper, we compared damage recovery, growth and yield of turmeric between manda 31 applied field and commercial field after typhoon occurred.

## Materials and Methods

### 1. Procedures of the experiment

The investigation was carried out in 1999-2000 at the Subtropical Field Science Center of the University of the Ryukyus. The soil type of the fields was Shimajiri mahji (Dark-red soil). The soil contained 0.89% C, 0.11% N, 134 mg P/100g soil; exchangeable K, Ca, Mg and Na were 0.17, 10.8, 1.35 and 0.31 meq/100g soil, respectively. Soil pH was 5.25-6.74. The fields were plowed properly for turmeric cultivation and ridges were prepared mechanically maintaining 150 cm apart. Turmeric rhizome was planted to 5 cm depth in two rows on a ridge maintaining 30 cm distance on May 2, 1999. Overhead irrigation was provided immediately after turmeric seed-rhizome planting. Manda 31 at 100ppm was applied 10 times to leaf, soil or leaf and soil at a 15-day interval until November 1999, beginning from 2- to 3-leaf stage of turmeric plant. Three top dressing of chemical fertilizer (N : P : K=185.0 : 92.5 : 92.5) at 370 kg ha<sup>-1</sup> was applied at a 60-day interval starting 70 days after planting, and irrigation was provided immediately after fertilizer application. Hand hoeing was operated three times for weed management.

A big turmeric field was adjacent to the manda

experimental field, where manda 31 was not applied. This field was called commercial field of turmeric in this report. A strong typhoon with heavy rainfall occurred on September 22, 1999 caused severe damages in turmeric plants equally in all fields. Manda 31 was continuously applied on the experimental field, which resulted in rapid recovery of turmeric plants from injury. It was observed that turmeric plants in some rows of commercial field, which were adjacent to the manda 31 applied field, were healthier than the plants in far rows.

### 2. Procedure of data collection and statistical analysis

Turmeric was harvested from four rows (4 m long, 1.50 m ridge spacing) in manda 31 experimental field in February 2000. Commercial field (C) was divided into four blocks according to the distance from the manda 31 experimental field, namely, C: 4-11 (commercial field, 4 to 11 m distance from manda 31 experimental field), C: 11-18 (commercial field, 11 to 18 m distance from manda 31 experimental field), C: 18-25 (commercial field, 18 to 25 m distance from manda 31 experimental field) and C: 25-32 (commercial field, 25 to 32 m distance from manda 31 experimental field). Each block had four rows (4 replications). Turmeric was harvested from each row (1m long) of commercial field. Turmeric rhizome (yield) was dried at 85 °C for 48 hours by using electric oven and weighed. Dry weight of rhizome was calculated for per unit land area (m<sup>2</sup>). Means and standard deviations of samplings were determined by using analysis of variance (ANOVA).

Fisher's Protected LSD test at the 5% level was used for mean separation.

## Results and Discussion

A strong typhoon occurred on September 22, 1999 caused severe damages in turmeric field, and there was no difference in damage between manda 31 applied field and commercial field (Fig. 1). The period of July to November is very critical for turmeric cultivation, because the plant develops rhizomes (yield) during this period under Okinawan climatic condition in Japan. In manda 31 applied field, many new tillers, leaves and roots of turmeric developed after 15 days of typhoon occurred, which might be contributed to increasing yield until January. Similar result was reported in tomato plant due to the application of manda 31 (report from the Manda Fermentation Co. Ltd.). It was assumed that new roots developed rapidly with the application of manda 31, which supported the injured turmeric plants to develop new tillers and leaves. The plants in manda 31 applied field remained green up to December (Fig. 2). On the other hand, roots decayed after typhoon occurred in commercial field, and around 95% of shoots completely withered within two months. Rhizome was not developed in commercial field. It was observed that plants in few rows of commercial field, which were very near to manda 31 applied field had some new tillers and leaves. Turmeric was not harvested in commercial field because very few rhizomes were developed.

Turmeric yield was 2 to 3 times higher in the field where manda 31 (M) was applied than that in commercial field (C, untreated) (Fig. 3). Yield in C: 4-11 was significantly higher than that in far rows of commercial field. Yield decreased with the longer distance from the manda 31 applied field. Effect of manda 31 was not observed in C: 18-25 and C: 25-32 as compared to that in C: 4-11 and C: 11-18. This result indicates that plants in neighboring field up to 18 m distance from manda 31 applied field, are also benefited. It means that the activities of manda 31 may move up to 18 m from applied field. We assumed that manda 31 moved with heavy rainfall to the neighboring field. It was reported that chemicals or plant growth regulators move or leach with water<sup>7)</sup>. Other researchers of Manda Hakko reported that the activities of manda 31 could move by air, and plants are influenced by smell of manda 31 (report from Manda Fermentation Co. Ltd.). However, we need further experiment to evaluate the mechanism of movement of manda 31 activities to the neighboring field.

Above result indicated that the damaged turmeric plants developed new roots, tillers and leaves for the

application of manda 31 within two weeks of typhoon occurred, and these plants remained green up to December and resulted in satisfactory yield. On the other hand, the damaged plants in commercial field did not recover, and these plants withered rapidly. Turmeric yield was two to three times higher in manda 31 treated field than that in untreated field. Turmeric plants in commercial field, which were within 11 m from the manda 31 applied field, produced a significantly higher yield than that with the far distance. Effect of manda 31 was not observed on plants in rows with greater than 18 m distance from manda 31 applied field. The overall results indicate that the manda 31 is more effective in stress condition of plant, and the plants in neighboring field of manda 31 applied field may be benefited. It was assumed that manda 31 moved with heavy rainfall to the neighboring field. Further experiments are necessary to evaluate how manda 31 moves to neighboring field.

## Source of Materials

Manda 31, a fermented natural plant concentrate was provided by Manda Hakko Kabusiki Kaisha, Innoshima, Hiroshima 722-2192, Japan.

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## 万田31号施用が台風後のウコン (*Curcuma* spp.) の被害回復, 生育および 収量におよぼす効果

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キーワード：発酵自然植物凝集物 (万田31号), 万田31号活性の周辺効果, ウコン (*Curcuma* spp.) の収量, 被害回復力

### 要 約

万田31号は, 作物の収量と品質を高める発酵自然植物凝集物である. 万田31号がウコンの生育および収量に効果的であるかを調べるために, 1999年5月から2000年2月にかけて琉球大学の亜熱帯フィールド科学教育研究センターの実験圃場で試験した. 試験区を葉, 土壌, 葉と土壌の3つに分け, 100 ppmの万田31号を15日間隔で10回施用した. ところが, 1999年9月22日に強い台風が発生し, すべての圃場のウコンが大きな被害を受けた. しかしながら, 台風後のウコンの回復力に万田31号施用区と無施用区では大きな違いが見られ, 興味深い結果を示した. 万田31号施用区と無施用区における台風後のウコンの被害の回復, 生育および収量について調査した. その結果, 万田31号施用区では, 新しい分けつの発生と新芽が台風後15日目に確認でき, 約70%の植物体は, 万田31号の施用を続けることでウコンは順調に回復し, 台風後, 12月まで生育は良好であった. 一方, 万田31号施用区に隣接している無施用区においては, 施用区から4~11m離れた畝のウコン収量は, 11m以上離れたウコンの収量よりも有意に高く, 18m以上離れた畝の植物体は, 台風後40日以内に枯死した. 総じてウコンの収量は, 万田31号施用区が無施用区に比べて約3倍高かった. これらの結果は, 万田31号は台風によるストレスに効果的で, しかも, 万田施用区近隣の植物体にまで有利に働くと考えられる. 万田31号の効用は, 激しい降雨による流水によって隣接する圃場へ移動すると推察された.