Effects of Manda 31 on growth and yield of spinach (*Spinacia oleracea*)

Md. Amzad HOSSAIN[1], Singoro MATSUURA[2], Mitsuhiro DOI[2]
Ichiro NAKAMURA[1] and Yukio ISHIMINE[1]*

[1]*Subtropical Field Science Center, Faculty of Agriculture, University of the Ryukyus, Okinawa 901-0213, Japan*
[2]*Manda Hakko Kabusiki Kaisha, Hiroshima 722-2192, Japan*

Abstract: Manda 31, a fermented natural plant concentrate, improves yield and quality of crops, vegetables and fruits without any hazard of environment factors. A glasshouse experiments was conducted to evaluate the effects of Manda 31 on growth and yield of spinach at the Subtropical Field Science Center of the University of the Ryukyus, Japan. Manda 31 at 100ppm was sprayed to plant shoots three times at a 10-day interval beginning 3- to 5-leaf stage. Water was adequately sprayed to control plants. Leaf was greener and leaf senescence occurred slowly when spinach was grown with Manda 31. Number of leaves, leaf area, root biomass and yield (shoot biomass) per plant were significantly increased with the Manda 31 application, as compared to control plant. This study indicates that Manda 31 is effective for promoting growth and yield of spinach.

Key words: Manda 31 (fermented natural plant concentrate), *Spinacia oleracea*, vegetable, yield.

Introduction

Environmental problems caused by chemical application in agriculture have received increased attention in every country (Erisman et al. 2001; Neera et al. 1999; Sharifuddin and Zaharah 1991). Chemicals are the causes of water contamination, air pollution, degradation of soil fertility, soil microorganism hazards, health hazards and food risk (Li et al. 1999; Neera et al. 1999). Farmers are advised not to use chemicals and to use organic fertilizers for good qualities of crops, vegetables, fruits and flowers. But it is a difficult task to increase yield and qualities of plants. Manda 31 is a fermented natural plant concentrate, which improves yield and quality of crops, vegetables and fruits without any hazard of environment factors (Hossain et al. 2000, 2002; Ishimine et al. 1999; Nakamura et al. 2001; Tsurumaki 1991). Manda 31 is produced from 50 natural plant materials, and it contains glycine, alanine, serine, praline, valine, threonine, isoleucine, lysine, leocine, glutamine, methionine, histidine, phenylalanine, arginine, tryptophane, asparagine, cystine and tyrosine. These components somehow promote germination, growth, yield and quality of plants (Hossain et al. 2000; Ishimine et al.1999). Many farmers reported that Manda 31 is more effective in stress condition of plants, and plants in neighboring field of Manda 31 applied field are also benefited (Hossain et al. 2004).

Spinach (*Spinacia oleracea*) is one of the important leaf vegetables of amaranthaceae family in the world. It was first cultivated in central Asia, perhaps in Persia (www.nationmaster.com/encyclopedia/Spinach). Spinach contains protein, vitamin-A, vitamin-B1, vitamin-B2, vitamin-C, vitamin-E, vitamin-K, Mn, Mg, Ca, K, Cu etc., which are very important for keeping good health (The World's Healthiest Foods). Present study has been conducted to evaluate the effects of Manda 31 on growth and yield of spinach.

Materials and Methods

Plant cultivation procedure

The experiment was conducted from November 20, 2003 to January 10, 2004 in the glasshouse of the Subtropical Field Science Center, University of the Ryukyus, Okinawa, Japan. Two treatments with three replications of this experiment were (1) control plant and (2) Manda 31 applied plant. Six plastic planters (60 cm long, 20 cm width and 20 cm height) were used, and each was filled with 10 kg of air-dried soil (Shimajiri

* Corresponding author (E-mail: iyukio@agr.u-ryukyu.ac.jp)

Mahji, Dark-red soil, pH 5.5-6.5) and 0.5 kg compost fertilizer (farm-yard manure). Forty-five seeds of spinach plant were sown at a depth of 1 cm maintaining 4 cm spacing, and thinned to the healthiest 15 plants per planter after all seedlings emerged. The plants were watered adequately every day. Manda 31 at 100ppm was sprayed to the plant leaves until the solution begins to drip from leaves, and it was applied three times at a 10-day interval beginning 3- to 5-leaf stage (20 days after seed sowing). For the control treatment, water was sprayed to plant shoots adequately. No chemical fertilizer was applied in this experiment.

Data collection and statistical procedure

Plant height, number of leaves per plant, leaf area per plant, and fresh and dry weight of shoots were measured at harvest. Roots were washed carefully with tap water and weighed. Plant parts were oven-dried at 80 ℃ for 48 hr and weighed. Mean value was calculated from 15 plants for each replication (planter). Then means and standard deviations (SD) of three samplings (three replications) were determined using analysis of variance (ANOVA). Student's t-test at the 5% level of significance was used to compare treatment means.

Results and Discussion

Plant height of spinach was slightly increased with the application of Manda 31 though not significantly (Fig. 1). Similar result was found in corn plant

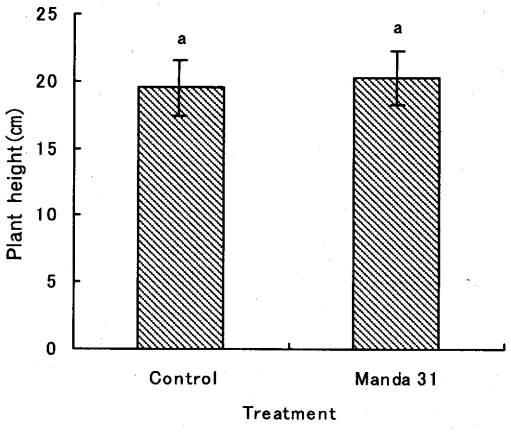

Fig. 1. Effect of Manda 31 on height of spinach vegetable. Data are means ± SD of 3 replications. Bars with the same letter are not significantly different at the 5% level, as determined by t-test.

(Hossain et al. 2003). It was observed that leaf in Manda 31 applied plant was wider but leaf elongation was not improved. Number of leaves per plant was significantly higher with the Manda 31 application than that with the control plant (Fig. 2). Leaf is the

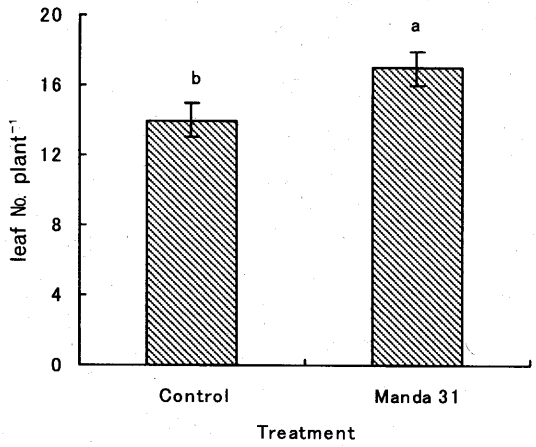

Fig. 2. Effect of Manda 31 on number of leaves of spinach vegetable. Data are means ± SD of three replications. Bars with the same letter are not significantly different at the 5% level, as determined by t-test.

yield of spinach therefore higher number of leaves is expected to obtain higher yield. Hossain et al. (2003) also reported that number of leaves was increased with the Manda 31 application in corn and marigold flower. Leaf area per plant was significantly increased for the application of Manda 31 as compared to control plant (Fig. 3). Leaf was found to be wider, and number of

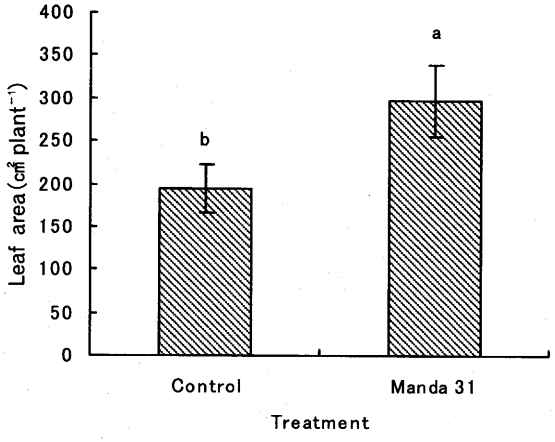

Fig. 3. Effect of Manda 31 on leaf area of spinach vegetable. Data are means ± SD of 3 replications. Bars with the same letter are not significantly different at the 5% level, as determined by t-test.

leaves was higher in Manda 31 applied plant, which resulted in higher leaf area per plant. Several studies also reported similar results in various plants treated with Manda 31 (Hossain et al. 2000; Ishimine at al. 1999; Nakamura et al. 2001; Tsurumaki 1991). Higher leaves usually receive higher solar energy, which ultimately contribute to higher yield of plants. Leaves were found

to be greener and leaf senescence occurred slowly when the plant was grown with Manda 31, may due to the higher chlorophyll content. The leaves contained higher chlorophyll might result in higher yield through increased photosynthesis. Because chlorophyll content (SPAD value) in leaf is positively correlated with the CO_2 exchange rate (CER), which indicates that photosynthetic rate increases with the increasing chlorophyll content (Sarker et al. 2002).

Root biomass of spinach increased significantly with the Manda 31 application as compared to control plant (Fig. 4). Soil in Manda 31 applied planter was

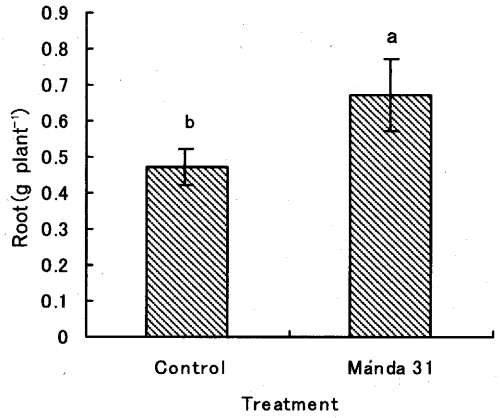

Fig. 4. Effect of Manda 31 on root (dry weight) production of spinach vegetable. Data are means ± SD of three replications. Bars with the same letter are not significantly different at the 5% level,, as determined by t-test.

appeared to be comparatively loose than in control planter, because Manda 31 solution was dripped to soil from leaves when applied adequately. Manda 31 contains some microorganisms, which may promote the process in decomposition in soil. Aeration occurs more in loose soil, which could enhance root growth. Longer roots usually uptake higher nutrient from deeper soil layer than shorter root. As a result growth and yield of plants are naturally increased with the higher nutrient absorbed. Previous study also reported that Manda 31 improves edaphic conditions, which enhance plants to grow properly and result in higher yield (Hossain et al. 2000).

Dry weight of shoot (yield) was significantly increased for the application of Manda 31 as compared to control plant (Fig. 5). It was observed that leaf in Manda 31 applied plant was higher in number, wider and thicker than control plant, which resulted in higher dry weight of shoot. Higher shoot of plants resulted in higher yield, which agreed to the results in different studies (Ishimine et al. 1999; Hossain et al. 2000; 2003). Another studies reported that Manda 31

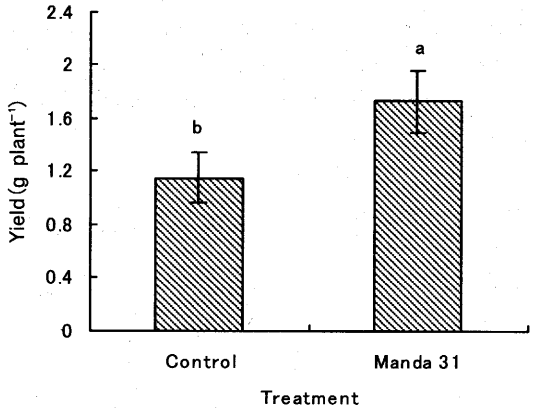

Fig. 5. Effect of Manda 31 on yield (shoot dry weight) of spinach vegetable. Data are means ± SD of three replications. Bars with the same letter are not significantly different at the 5% level, as determined by t-test.

contains different amino acids, which somehow promote growth, yield and quality of crops, vegetables, fruits and flowers (Manda Hakko). This study indicates that Manda 31 could be effective for promoting growth and yield of spinach plant.

Source of Materials

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万田31号がほうれん草の成長及び収量に及ぼす影響

モハメド アムザド ホサイン*、松浦新吾郎**、
土井光弘**、仲村一郎*、石嶺行男*

キーワード：万田31号（万田発酵自然植物凝縮物）、ほうれん草、野菜、収量

万田31号は、自然災害を含めて作物、野菜、果物の収量と品質を高めることが報告されている。

ここでは、万田31号の使用がほうれん草の生育、収量に及ぼす効果を調べるために琉球大学農学部亜熱帯フィールド科学教育研究センターのガラス室において実験を行った。まず万田31号（100ppm）を、葉の枚数が３－５枚になった時から十日間隔で三回散布した。対照区では水だけを散布した。万田31号を施用した区では対照区に比べ葉の色はより濃緑色で葉の老化が緩やかであった。１個体あたりの葉の枚数と面積では万田31号施用区が対照区に比較し有意であった。根の乾物量と収量は万田31号施用区で有意に増加した。

以上の実験結果から万田31号はほうれん草の生育、収量を高める効果があると考えられえる。

* 琉球大学農学部
** 万田発酵株式会社