万田31号がトウモロコシ(Zea mays)の生育に及ぼす影響

Effect of Manda 31 on Growth of Corn (*Zea mays*)

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Key words : Fermented natural plant concentrate, Manda 31, Shoot and root growth, Corn (*Zia mays*).

Summary

Glasshouse experiment was conducted to determine the effect of Manda 31 on shoot and root growth of corn at the Subtropical Field Science Center, University of the Ryukyus, Japan. The treatments of the experiment were W: water application (control), M-10: Manda 31 application at 100 ppm and M-5: Manda 31 application at 200 ppm. Manda 31 solution or water was applied to plants until the solution or water begins to drip from the plants, at 15- day intervals starting 2- to 3-leaf stage. Plant length, leaf area and leaf dry weight of corn were increased with the Manda 31 applied at 100 ppm and 200 ppm. Shoot and root production of corn were significantly increased when Manda 31 was applied 3 to 5 times, as compared to control plants. Manda 31 applied only one time at early growth stage could not increase shoot and root biomass of corn remarkably. Manda 31 at 200 ppm was more effective on shoot and root biomass production of corn than at 100 ppm. Above results indicated that Manda 31 at 200 ppm could be applied 3 to 5 times for higher shoot and root production of corn.

Introduction

Human existence depends on safety food and healthy environments (Erisman et al., 2001; Neera et al., 1999; Sharifuddin and Zaharah 1991). Various chemicals using in agriculture for additional food production 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; Swanton and Weise 1991). Agricultural and environmental scientists suggested to reduce or cancel chemical application in agriculture, garden and forestry (Erisman et al., 2001). It is assuming that natural derivatives may be used in agriculture for providing safety food and healthy environment. Manda 31, a fermented natural plant concentrate derived from more than 50 natural plant species, improves yield and quality of crops, vegetables and fruits without any hazards of environmental factors and human health (Hossain et al., 2000, 2002; Ishimine et al., 1999; Tsurumaki 1991). It contains ammoniacal nitrogen, nitrate nitrogen, water soluble organic nitrogen, water insoluble organic nitrogen, soluble potash (K_2), glycine, alanine, serine, proline, valine, threonine, isoleucine, lysine, leucine, glutamine, methionine, histidine, phenylalanine, arginine, tryptophane, asparagine, cystine and tyrosine.

Ichiro et al. (2001) reported that Manda 31 promoted the efficacy of chemical fertilizer (compound fertilizer of N, P and K) on turmeric yield. Manda 31 applied to leaf, soil or both leaf and soil increased 15-19% of turmeric yield (Hossain et al., 2000, 2002; Ichiro et al., 2001; Ishimine et al., 1999). It is also assumed that Manda 31 may enhance photosynthetic and soil microbial activities, which support plants to grow well for higher yield with better quality (Hossain et al., 2000, 2002; Ichiro et al., 2001; Ishimine et al., 1999). Corn (*Zea mays*) is one of the most important crops in the world which provides maximum food for human beings and animals. Present study was conducted to evaluate the effect of Manda 31 on shoot and root biomass production of corn considering pasture.

Materials and Methods

Glasshouse experiment was conducted from September 14 to December 14, 1999 at the Subtropical Field Science Center, University of the Ryukyus, Okinawa, Japan. The treatments of the experiment were W: water application (control), M-10: Manda 31 application at 100 ppm and M-5: Manda 31 application at 200 ppm. Each treatment consisted of 12 replications.

Twelve kg of air dried dark red soil (Shimajiri Maji, pH 5.8-6.4) was taken per pot (wagner pot, size 0.05 m^2, 30 cm depth), and nitrogen (N) fertilizer at 2 kg/a (a $=100$ m^2) was mixed with soil. Five seeds of corn (*Zea mays*, cv. top

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corn) were sown to 2 cm soil depth in each pot, and after emergence plants were thinned to the healthiest one per pot 7 days after seed sowing (DAS). Manda 31 solution (100 or 200 ppm) or water was applied to plants until the solution or water begins to drip from the plants at 15-day intervals starting 15 DAS (2- to 3-leaf stage). Water was applied once a day to maintain adequate soil moisture. Average air temperature in the glasshouse ranged from 26 to 33 ℃.

Plant length and number of leaves were recorded at 15-day intervals starting 15 DAS. Four plats were harvested from each treatment at 30, 60 and 90 DAS. Data on leaf area, and dry weight of leaves, stems and roots were recorded every sampling date. Plant samples were dried at 80 ℃ for 48 hours using an electric oven. Data were subjected to analysis of variance (ANOVA) and means were separated using Fisher's Protected LSD test at the 5% level of significance.

Results and Discussion

Length of corn plant was slightly increased with the application of Manda 31 at 100 or 200 ppm than control plant (water applied) though not significantly (Fig. 1). Similarly, turmeric plant length was promoted with the application of Manda 31 at 100 ppm or 200 ppm in other studies (Hossain et al., 2002; Ishimine et al., 1999). Highrer plant length is expected to provide higher shoot biomass or yield of crop, vegetable and fruit (Hossain et al., 2000, 2002). Leaf area of corn was significantly increased with the application of Manda 31 at 100 ppm or 200 ppm than control plant (Fig. 1). Increased leaf area usually receives higher solar energy, which ultimately increases crop yield. Leaf of corn grown with the Manda 31 was more green, which was may be due to the higher chlorophyll content in leaf (Hossain et al., 2002). Similar effects of Manda 31 on leaf were reported in turmeric plant (Hossain et al., 2002; Ichiro et al. 2001). Higher chlorophyll usually promotes photosynthesis rate, which usually contributes to increase crop-yield. Dry weight of leaf was significantly increased with the Manda 31 applied at 200 ppm (Fig. 1).

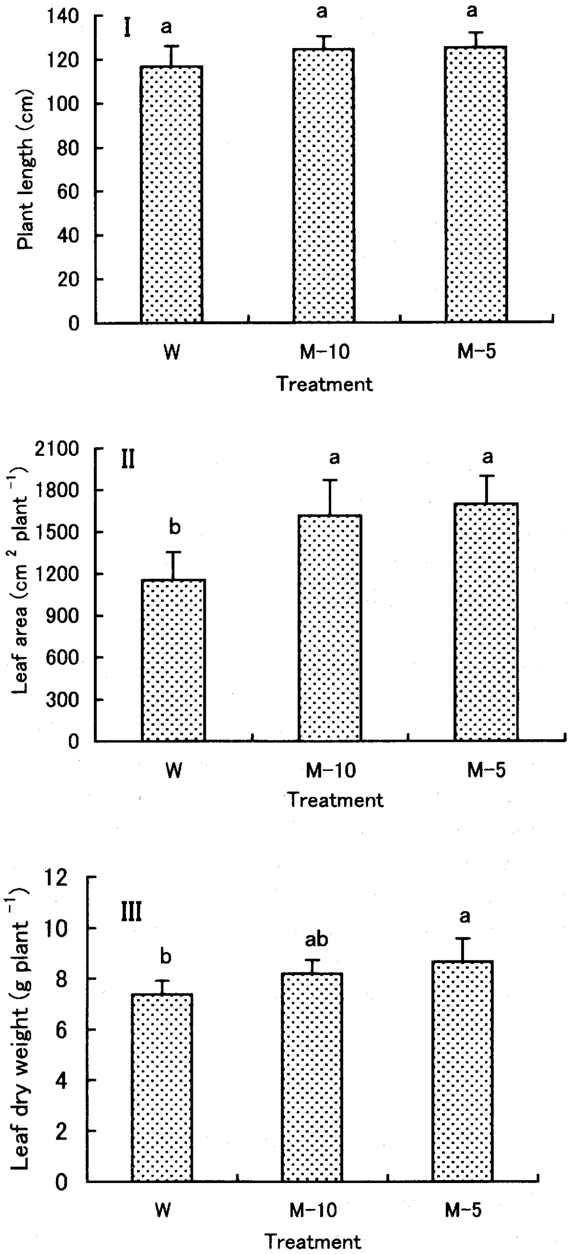

Fig. 1. Effect of Manda 31 on plant length (I), leaf area (II) and leaf dry weight (III) of corn. W, M-10 and M-5 represent water, Manda 31 at 100 ppm and Manda 31 at 200 ppm, respectively. Data are means ± SD of 4 replications. Bars with the same letter are not significantly different at 5% level, as determined by LSD test.

Corn grown for 60 and 90 days with the application of Manda 31 obtained significantly higher shoot biomass as compared to control plants (Table 1). On the other hand, corn grown for 30 days with the application of Manda 31 at 100 ppm or 200 ppm did not receive significantly higher shoot biomass than control plant, because Manda 31 was applied only one time which was not enough to promote shoot growth remarkably. Manda 31 was applied 3 times to corn grown for 60 days and 5 times for the 90 days, which were enough to promote shoot production significantly. Manda 31 at 200 ppm applied to corn resulted in a remarkable higher shoot biomass than at 100 ppm. Whereas in turmeric plant, Manda 31 at 100 ppm resulted in a higher shoot biomass than at 200 ppm (Ishimine et al., 1999), indicating that concentration of Manda 31 application differs with the plant species for higher shoot production. Corn required 200 ppm of Manda 31 for higher shoot production which may promote corn grain. It was reported that dry matter production of aboveground shoot of any plant was correlated with yield (Lubis et al., 2003).

Table 1. Effect of Manda 31 on shoot production of corn

Treatments	Shoot dry weight		
	Days after planting		
	30	60	90
	g $plant^{-1}$		
W (control)	3.62 (100) a	15.63 (100) b	18.89 (100) b
M-10	4.14 (114) a	19.72 (126) a	20.26 (107) ab
M-5	4.49 (124) a	20.28 (130) a	23.52 (126) a

Note: W, M-10 and M-5 represent water, Manda 31 at 100 ppm and Manda 31 at 200 ppm, respectively. Data are means of 4 plants. Data in the parentheses indicate percentage of the control plant. Value of control plant considered 100%. Means followed by the same letter within each column are not significantly different at 5% level, as determined by LSD test.

Table 2. Effect of Manda 31 on root production of corn

Treatments	Root dry weight		
	Days after planting		
	30	60	90
	g $plant^{-1}$		
W (control)	1.06 (100) a	3.29 (100) b	3.06 (100) b
M-10	1.12 (106) a	4.33 (132) a	3.77 (123) a
M-5	1.21 (114) a	4.36 (133) a	3.85 (126) a

Note: W, M-10 and M-5 represent water, Manda 31 at 100 ppm and Manda 31 at 200 ppm, respectively. Data are means of 4 plants. Data in the parentheses indicate percentage of the control plant. Value of control plant considered 100%. Means followed by the same letter within each column are not significantly different at 5% level, as determined by LSD test.

Root production of corn recorded at every sampling date was influenced by Manda 31 application (Table 2). Root production at 60 and 90 days after seed sowing (DAS) was significantly higher when Manda 31 was applied 3 and 5 times, respectively, as compared to control plant (Table 1). On the other hand, significant effect was not observed on root production recorded at 30 DAS, because Manda 31 was applied to corn only one time. Manda 31 at 200 ppm applied to corn gave a remarkable higher root biomass than at 100 ppm, indicating that Manda 31 at 200 ppm was more effective on root production of corn. Higher root of plant results in higher yield, which was reported in rice plant (Mazid 1993).

Present study indicated that plant length, leaf area, leaf dry weight, shoot dry weight and root dry weight of corn were increased with the application of Manda 31. Shoot and root production were significantly increased when Manda 31 was applied to plants 3 to 5 times. Manda 31 at 200 ppm applied to corn resulted in a remarkable higher shoot and root biomass than at 100 ppm. This study suggested that Manda 31 at 200 ppm could be applied 3 to 5 times for higher shoot and root production of corn.

Source of Material

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

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万田31号がトウモロコシ（*Zea mays*）の生育に及ぼす影響

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キーワード：発酵自然植物凝集物、万田31号、地上部および地下部の生育、トウモロコシ(*Zea mays*)

万田31号がトウモロコシの地上部および地下部の生育に及ぼす影響を調べるために、琉球大学農学部附属亜熱帯フィールド科学教育研究センターのガラスハウス内で実験を行った。

実験は、W-対照区（水のみを散布)、M-10処理区（万田31号10000倍液を散布)、M-5処理区（万田31号5000倍液を散布）とした。葉が2～3枚展開後、15日間隔で万田31号溶液および水を植物全体に十分散布した。

M-10およびM-5の両処理区ともW（対照区）に比較して、トウモロコシの茎長、葉面積、葉乾物重が増加した。万田31号溶液を3～5回散布したトウモロコシは、対照区に比較して地上部および地下部の生産が明らかに増大した。初期生育段階において、万田31号溶液を1回散布した場合、地上部および地下部に大きな変化は認められなかった。M-5処理区はM-10処理区に比較して、地上部および地下部ともに乾物生産が増大した。

以上の結果より、トウモロコシの地上部および地下部のバイオマス生産を高めるには、万田31号5000倍液を3～5回散布することが有効であることがわかった。

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